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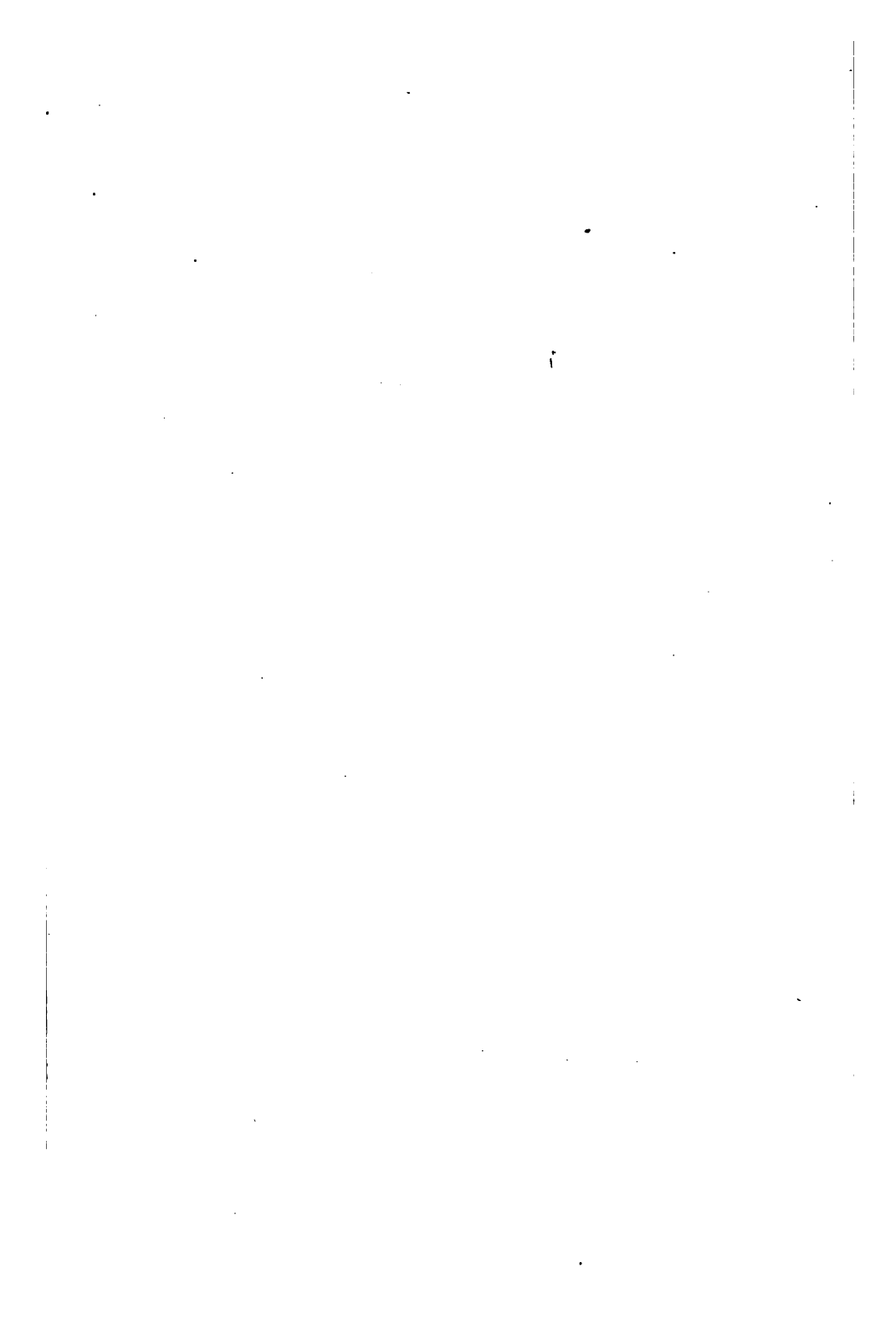
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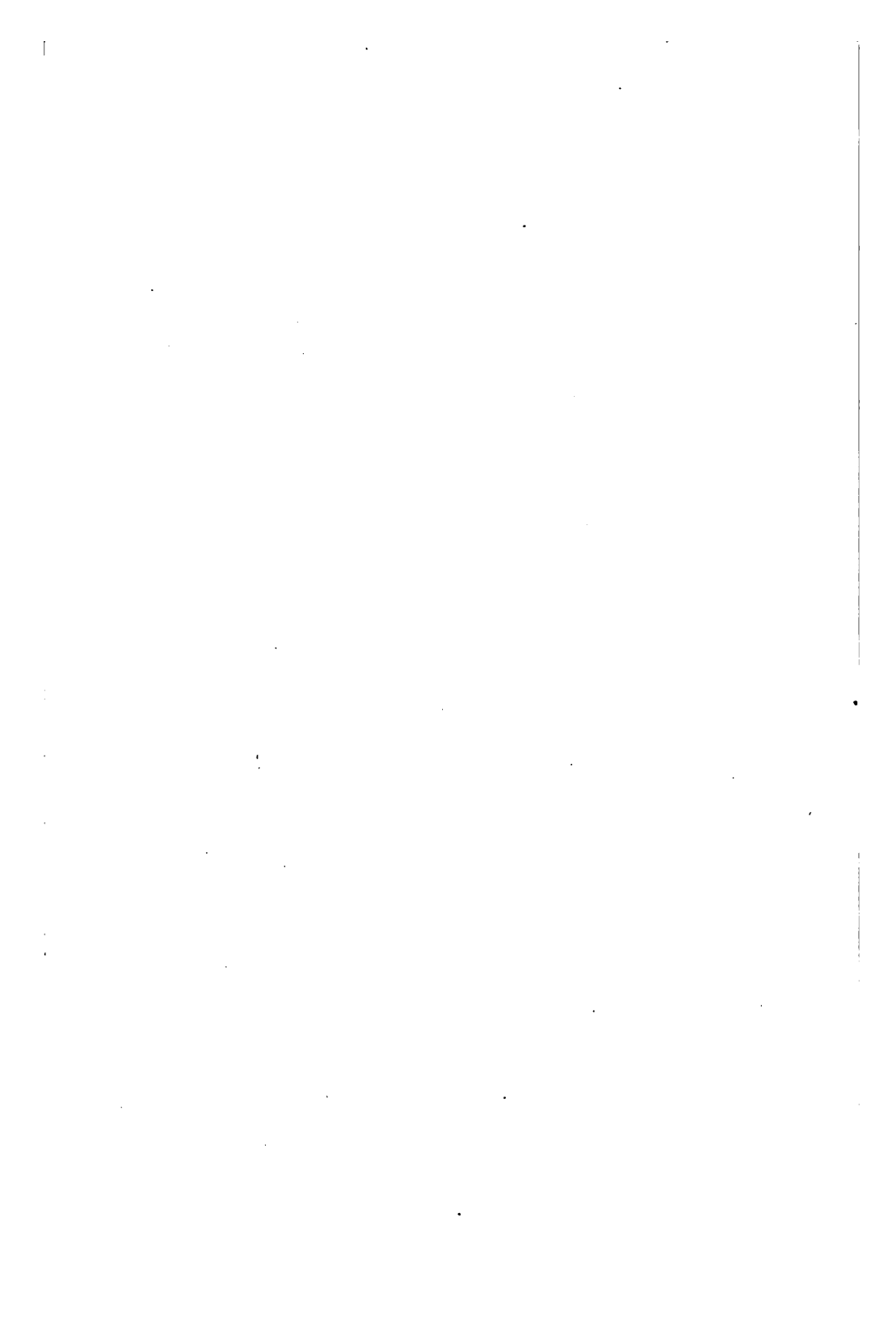
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A HANDBOOK OF MENTAL TESTS



A HANDBOOK OF MENTAL TESTS

A Further Revision and Extension
of the Binet-Simon Scale

By

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EDITOR'S INTRODUCTION

For a number of years the writer of this Introduction, with the assistance of his advanced students in the University of Wisconsin, has conducted experiments to determine the validity and usefulness of the Binet-Simon scale for the measurement of intelligence. As a result of this experimentation, the conclusion has been reached that while the Binet-Simon tests are based upon sound principles in the diagnosis of intelligence, they are still defective in certain ways, and chiefly in two respects. In the first place, the tests depend too largely upon verbal responses only from a subject under examination. The writer has accumulated evidence which has convinced him that, in order to measure intelligence in its major aspects, it is necessary to introduce into the Binet-Simon system tests which will require a subject to perform in other ways than merely to answer questions, or give linguistic solutions of problems.

Again, it has become clear to the writer that the method of scoring adopted in the Binet-Simon system often proves to be inaccurate, for the reason that the judgment of the scorer is the main factor in determining the value of the response to a test. In the writer's experiments, the plan has been tried of having several examiners present during the examination of a subject. Each examiner has estimated the value of every response. Often these estimates have differed because each examiner has been more or less biased in interpreting a subject's responses; and so the predilections and mental attitude of the examiner has always to be taken account of in the results of an examination. These variable factors will of course render any scale for the measurement of intelligence somewhat unreliable.

In attempting to correct these defects in the Binet-Simon system, the writer has tested some devices of his own, and he has tried out suggestions made by others who have revised the Binet-Simon scale. In the process of looking about for a revision of the scale which would give a larger place to actual performance as compared with linguistic response, and which would insure a higher degree of accuracy in scoring the results of an examination, the writer came across the revision by Kuhlmann, who has developed a modified Binet-Simon scale as an outgrowth of his work at the School for the Feeble-Minded, Faribault, Minnesota. It seemed to the writer, upon examination of the Kuhlmann revision, that the two chief defects in the Binet-Simon scale had been remedied more adequately and satisfactorily than had been accomplished in any other revision. The writer consulted persons in different parts of the country who had been using the Kuhlmann scale, not only in respect to the two major points mentioned above, but also in regard to minor details, and their testimony confirmed his own conviction,—that Dr. Kuhlmann has succeeded in producing a very useful scale for the measurement of intelligence.

So the writer requested Dr. Kuhlmann to prepare his system for publication. This will explain how this book has come to be published. The writer believes that it will make a distinct contribution to the solution of the problem of diagnosing intelligence. Especial pains have been taken to present this revised Binet-Simon system in such terms and in such an arrangement of type, headings and paragraphing that it will be clear to any one who wishes to use it how it is to be employed, alike in respect to the method of administering the tests and the method of scoring the results. It will be possible for a teacher, a student of psychology, a parent, a worker in a juvenile court or in an institution for defectives or delinquents, to use the Kuhlmann scale readily and ac-

curately after the reading of this volume. The use of the scale does not require an extended knowledge of the sciences, especially psychology, upon which it is based.

It is reasonable to assume, considering the present widespread interest in ways and means for measuring intelligence accurately, that any contribution to the solution of the problem will be welcomed by those who are responsible for the care or teaching or guidance of the young. This book has, in addition to other advantages, the special advantage,—that the tests have not been widely published in the newspapers, which has been the case with some of the other systems for diagnosing intelligence; and this has rendered them useless in many sections of the country where young as well as older persons have become familiar with many of the tests.

M. V. O'SHEA.

The University of Wisconsin,
November, 1920.

A HANDBOOK OF MENTAL TESTS

ical, educational, social, legal, and philanthropic problems. The inmates of the Minnesota School for Feeble-Minded have furnished an invaluable means of experimentation with mental tests and the evaluation of other criteria and methods of determining degrees of mental development. Normal children of the public schools have always been accessible for the standardization of tests and establishment of norms. A good number of competent assistants have been available to help in every phase of the work. The present manual gives but a meagre insight into the magnitude of the task. The procedure in devising new tests and scales must still necessarily be largely empirical. Only by laboriously trying out many do we find a few that are satisfactory. The numerous tests that proved unsuccessful are not discussed, though they all contributed to the final result, and helped to reveal general principles that will be very useful in guiding future efforts.

The field of mental tests has been one of intense activities ever since the unprecedented success of the original Binet-Simon scale became generally known. The writer has made good use of many important contributions by other workers, which the references given can acknowledge only in a very inadequate way. Special thanks are due to the Minnesota State Board of Control, whose constant zeal for the highest efficiency of the public institutions under its charge, has led to giving the writer a free hand, encouragement, and liberal material assistance in the pursuit of every investigation that aimed at the increase in that efficiency. A similar attitude and progressive views actuated public school authorities, especially Superintendent John Munroe of the public schools of Faribault, Minnesota, to give unlimited access to their schools for making tests and study of children's records. Lastly, a number of assistants have done the major part of the testing and have helped in many other ways. Miss

Anna A. Masterson, intern in our laboratory, Miss Minnie A. Toner, and Miss Carrie Pierce, public school teachers, gave a number of the upper age tests to several hundred normal children. Miss Frances Lowell, Research Assistant, helped to secure norms for one of the tests and contributed statistical data. Miss Maud A. Merrill, Research Assistant, did a large part of the testing with practically all of the new tests, contributed the intelligence quotient table beginning with the chronological age of ten years, and read the manuscript. Miss Rose Anderson, and Miss Katharine B. Graves, Research Assistants, gave valuable suggestions concerning the individual tests and the directions for giving them. Finally, my wife did an equal share of the testing with all of the new tests, and assisted in the tabulation of data.

F. K.

CHAPTER I INTRODUCTORY

Nature of the Revision. The system of mental tests presented in this manual is a much revised and extended Binet-Simon scale. The changes made cover the following points. (1) Standardization of the procedure in giving the tests. The directions for giving each test are made complete, but as brief and explicit as possible. In some instances they are more detailed than found in any previous revision of the tests, as directions to be followed under various special circumstances that arise occasionally have been added. With the average case these extra directions are not needed. This was made possible from the extensive experience in giving the tests to thousands of cases of all ages and grades of intelligence. This more detailed standardization of the procedure in giving the tests facilitates their use by relatively inexperienced examiners, results in necessary uniformity, and insures more ready comprehension on the part of the subject examined as to what he is to do in each test.

(2) Correction of the tendency of the original scale to measure too high at its lower end and too low at its upper end. The former required changing the tests at the lower end, and the latter required in addition an extension of the scale upwards and a different method of scoring mental ages when the subject passes several tests in the highest age-group of the scale.

(3) Elimination of nineteen of the original tests that were found unsatisfactory for one reason or another. The following are the tests that were dropped out entirely:

Giving age (Age-group VI).

Repetition of a sentence of sixteen words (Age-group VII).

Copying a written phrase (Age-group VII).

Counting thirteen pennies (Age-group VII).
Reading for two memories (Age-group VIII).
Writing from dictation (Age-group VIII).
Naming the days of the week (Age-group IX).
Reading for six memories (Age-group IX).
Naming the months of the year (Age-group X).
Naming nine pieces of money (Age-group X).
Questions of comprehension (Age-group X).
Using three words in one sentence (Age-group XI).
Giving sixty words in three minutes (Age-group XI).
Repetition of seven numerals (Age-group XII).
Rhyming words (Age-group XII).
Problems of diverse facts (Age-group XII).
Drawing a cut in a twice folded piece of paper (Age-group XIII).
Drawing the figure of two juxtaposed triangles (Age-group XIII).
Distinction between abstract terms (Age-group XIII).

(4) Increase in the number of tests to eight in each age-group above two years. This adds to the reliability of the results obtained in any individual examination. It also makes more possible the adaptation of the scale in abbreviated form to different classes of cases with special defects that makes some of the tests inapplicable, as cases with defective hearing or vision, with speech defect, or with motor incoordinations.

With each of these classes the inapplicable tests may be eliminated, and usually enough applicable tests remain to give a fairly reliable result.

(5) Extension of the original scale at both upper and lower ends. The original, beginning with tests for the age of three years, did not serve to determine mental ages correctly much below five. The present scale begins with tests for the age of three months. Its incompleteness at its upper end and its inapplicable method of scoring at this point made the results uncertain just at a point where in some fields of work certainty was required most of all. With the original scale and previous revisions of it a reliable mental age could not be obtained much above the mental age of ten, that is, for older chil-

dren and adults near the borderline between the normal and mentally deficient.

There are now one hundred twenty-nine tests, counting a repeated test for each age-group in which it is used, in place of the fifty-six tests of the original scale. Thirty-seven of the original are retained, but a number of these are modified or shifted to other age-groups. A special effort was made throughout to eliminate as far as possible the personal factor of the examiner from the results obtained in an examination. One of the chief ways of doing this is to use tests in which the scoring of responses is simple and unambiguous. Practically all the new tests added for years above two score in terms of the time it takes to do the test and the number of errors made. This anyone can do. The use of this manual, therefore, requires much less general training for the examiner than does any other system of tests.

Data on which the Revision is Based. The revision represents the results of seven years of continuous work on the part of the writer and a number of assistants engaged in the mental examination of about 7,000 children and adults. A single examination of a child lasted from thirty minutes to over an hour. Considerably over a hundred new tests were tried out, many of them in a number of different forms before they were finally accepted or discarded. The preliminary tryouts were usually made on inmates of the Minnesota School for Feeble-Minded, whose mental ages as found by previous tests were already known. As fast as apparently satisfactory tests were found they were tried out on normal children of different ages to establish the required norms and to make further adjustments in the tests themselves. The normal children below school age were secured chiefly from "baby contests" held in connection with several county and state fairs, from one state orphans' school, and from kindergartens of the public schools. The others

were secured from the public schools, including the High School. Over 2,000 normal children figure in these examinations to establish norms for the tests, including the tests for the original scale that were tried out anew. The number of normal children to whom each test of the present scale was given is shown in the following table:

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-----------|-----|-----|-----|-----|-----|-----|-----|------|
| 3 Months | 20 | 20 | 20 | 20 | 20 | ... | ... | ... |
| 6 Months | 46 | 46 | 46 | 46 | 46 | ... | ... | ... |
| 12 Months | 83 | 83 | 83 | 83 | 83 | ... | ... | ... |
| 18 Months | 98 | 98 | 98 | 98 | 98 | ... | ... | ... |
| II. | 71 | 71 | 71 | 71 | 71 | ... | ... | ... |
| III. | 45 | 45 | 45 | 45 | 8 | 45 | 9 | 10 |
| IV. | 12 | 12 | 12 | 12 | 39 | 41 | T | 39 |
| V. | 80 | 80 | 80 | 80 | 80 | 152 | 77 | T |
| VI. | 152 | 152 | 152 | 263 | 145 | 177 | 147 | 86 |
| VII. | 263 | 263 | 263 | 263 | 356 | 152 | T | 356 |
| VIII. | 356 | T | 356 | 170 | 152 | T | 174 | 103 |
| IX. | 372 | 406 | 354 | 406 | 384 | 145 | T | 103 |
| X. | 354 | 103 | 79 | 191 | 357 | 493 | 154 | 322. |
| XI. | 357 | 327 | 358 | 493 | 154 | 304 | 322 | 333 |
| XII. | 79 | 493 | 154 | 304 | 322 | 333 | 326 | 332 |
| XIII-XV. | 304 | 322 | 333 | 326 | 62 | 296 | 77 | 62 |

In this table the numbers of the tests, 1 to 8, in each age-group are given, in the first line. The age-groups are indicated in the first column on the left. The figures in the table give the number of normal children to whom each test was given. Thus, test 4 in age-group VI was given to 263 children. The T indicates tests for which Terman secured norms, and which are taken from his 1916 revision of the Binet-Simon tests.

General Accuracy of the Scale. The age classification of these children was made according to their nearest birthday. For example, all children from five years six months to six years five months were classed as six years old. The average of such a group was then so nearly exactly six, seven, eight, etc., years as to make the discrepancy entirely negligible. The average mental age as found by the revised scale for the children of each age was computed. The general accuracy of the tests is shown in the following figures, giving the comparison between age and mental age, and intelligence quotients:

| Age | 3 Mos. | 6 Mos. | 12 Mos. | 18 Mos. | 2 Yrs. | 3 Yrs. |
|--------------------|---------|---------|---------|---------|---------|---------|
| Average Men. Age.. | 2.85 | 7.08 | 13.80 | 20.16 | 2.16 | 3.18 |
| Average I. Q..... | .95 | 1.18 | 1.15 | 1.12 | 1.08 | 1.06 |
| Age | 4 Yrs. | 5 Yrs. | 6 Yrs. | 7 Yrs. | 8 Yrs. | 9 Yrs. |
| Average Men. Age.. | 4.26 | 5.17 | 6.04 | 7.00 | 8.13 | 9.14 |
| Average I. Q..... | 1.07 | 1.03 | 1.01 | 1.00 | 1.02 | 1.01 |
| Age | 10 Yrs. | 11 Yrs. | 12 Yrs. | 13 Yrs. | 14 Yrs. | 15 Yrs. |
| Average Men. Age.. | 10.16 | 11.15 | 12.00 | 13.00 | 14.00 | 15.00 |
| Average I. Q..... | 1.02 | 1.01 | 1.00 | 1.00 | 1.00 | 1.00 |

The intelligence quotient is the figure obtained by dividing the mental age by the age, and should be, of course, exactly 1.00 if the tests give exactly correct mental ages. It is seen that these average intelligence quotients are above 1.00 up to the age of four years. This is due to the "baby contest" children that were examined being brighter than average children. Had the tests been adjusted to give intelligence quotients of just 1.00 at these ages with these results the tests would have measured too low. A detailed analysis of the results made it possible to allow for this, but it is possible that they are not as accurately adjusted for these ages as for the ages above four.

Requirements of an Examiner. Distinction must be made between one who can obtain correct mental ages with these tests, and one who can correctly classify individuals examined as normal, sub-normal, feeble-minded, psychopathic, and so on. A good mental tester may not be able to diagnose the conditions to which these other terms apply, which are defined by law and by other sciences as well as by psychology. We are not concerned here with the diagnostician in this sense. In general, two things are required of a good mental tester. The first is to be able to control the subject of any age and disposition so as to get the best responses he is capable of in the tests. The second is to be able to give the tests correctly and score the responses correctly. Many people, especially school teachers with a year or more of teaching experience, possess the first qualification without special training. Others can acquire it by intelligent practice. Most failures among untrained mental testers are due to the lack of the second qualification. This is not because there is any inherent difficulty in giving the tests, but because the person in question has not learned the necessity of patiently learning directions and of practice in following

them minutely until their observance becomes habitual and automatic. The chief function of an extended psychological training to prepare one merely for mental testing lies in inculcating a comprehension of this necessity. A few individuals have or acquire this qualification readily without any extended scientific training. Roughly, about ten per cent. of grade teachers become entirely reliable mental testers after a month or more of supervised daily practice. They must continue the work, however, to keep up their practice. None are so inefficient as mental testers as not to be able to increase the accuracy of their judgment of a child's intelligence tenfold, when based on test results. These tests are intended for anyone of ordinary intelligence and carefulness who has occasion to use them, as well as for the specialist. The mental age that the user of the tests, who has no special training for mental examining other than practice in giving the tests, gets is usually fairly accurate. Misuse of the tests consists not so much in accepting this mental age as reliable, as in accepting such an examiner's interpretation of this result, and in placing him in the position of the specialist. To fill the position of a mental examiner graduation from a good university with specialization along the necessary lines, and some practical experience, should be the minimum requirement.

Classification. Assuming that mental age and intelligence quotient have been correctly determined, they can be made a basis of classification under different grades of intelligence. The intelligence quotient furnishes a much better basis for this than does the mental age. The mental age indicates the general abilities of the child at the time of the examination, but not what they are likely to develop into. If a child of eight has a mental age of six he has in general the abilities of the average normal child that is six years old. But his

mental age is not likely to remain six. The intelligence quotient on the whole remains roughly the same, and therefore tells us something about what his future and final mental age is likely to be. For feeble-minded children as generally found in institutions there is a general tendency for the intelligence quotient to decrease some with years. The intelligence quotient is, however, only a rough guide for making predictions in individual cases. Individual children vary much in their rate of mental development at different ages, and repeated examinations alone can determine with certainty what the final grade of intelligence of a child will be. Keeping these considerations in mind, we may attribute the following limits in intelligence quotients to different grades of intelligence commonly described in other terms.

| Grade Terms. | Range in I. Q. |
|--------------------|----------------|
| Idiots | 0- 24 |
| Imbeciles | 25- 49 |
| Morons | 50- 74 |
| Borderline | 75- 84 |
| Dull | 85- 94 |
| Average | 95-104 |
| Bright | 105-114 |
| Very bright..... | 115-124 |
| Superior | 125-149 |
| Very superior..... | 150-174 |
| Precocious | 175 and over. |

The first three of these grades are grades of feeble-mindedness. There is no complete agreement yet as to just where the line should be drawn between morons and borderline cases. Some place it at 70 instead of at 74. Others put so much stress on factors other than grade of intelligence as to draw the line considerably higher or lower in individual cases. The writer believes

that any case of mental arrest with an intelligence of 74 or lower may under any circumstance be properly classified as feeble-minded, and that some in the borderline group must also be treated as such because of other unfavorable traits combined with their mental retardation. The grades of intelligence proper for special classes for mentally retarded in the public schools depends on what it is aimed to do with these special classes. In general, children with intelligence quotients from 50 to about 85 fit in best with the work of such classes. Children of lower grades than this are not capable of doing enough three R work to make it worth while trying to teach them any and to exclude all three R work is not always practical. Cases with an intelligence of less than 50 are more properly institution cases. On the other hand, it is advisable to draw the line rather high for the upper end so as to include some cases who because of reasons other than lack of intelligence do not do better school work than many with still less intelligence, and are therefore from a pedagogical standpoint as much out of place in classes with normals as are those of lower grade. Moreover, the special class should serve to furnish an observation period for borderline cases, in order to determine their final classification with greater certainty.

Use of Mental Test Results. The application of mental test results is unlimited, for there are few circumstances in which it would not be desirable or of value to know the degree of intelligence of an individual, child or adult. The public schools, however, furnish the place and chief occasion for making the examinations. Here all become available for that purpose, and here also arises the first important occasion for taking a child's grade of intelligence into account. If all were examined here many social and other problems concerning their later lives might be solved. The first serious use of

mental test results was in the classification of subnormal children in the public schools. The great impetus to the further development of mental tests originated in their demonstrated usefulness in this field. It is unfortunate that the scope of their application has not developed in proportion. But this is a matter of time. If present tendencies are indicative of the future a mental test examination for every public school child will soon be the common practice, if it is not universally demanded by legislation. It is known that there are approximately as many children above average intelligence as there are below, and it is more important to take advantage of brilliancy than to try to salvage dullness. In the school grades as at present organized there are practically always children of about five different mental ages in any one grade, assumed by the schools to be alike capable to do the work of the grade they are in sufficiently well to pass into the next higher at the end of each year. To only about a third of them is the school work properly adjusted. The grouping of the children exclusively by mental ages instead of by their chronological ages would correct more than eighty-five per cent. of these misplacements.

CHAPTER II

GENERAL PRINCIPLES OF THE YEAR SCALE

By the year scale is meant a scale of measurement that measures in terms of number of years of average development, and expresses the result of a measurement in terms of mental age. Binet was the first to devise such a scale. His contribution, with that of his co-worker, Simon, however, consisted chiefly of the working out of a series of tests and their combination into a scale that actually determined the mental ages of children. In producing this scale their method seems to have been almost entirely empirical. By results, they finally found a number of tests that served the purpose of making a scale, ranging from the ages of three to thirteen. The principles involved in such a scale were not discussed by these authors. What we know of these principles today is the contribution of a number of later writers.¹ By degrees we are learning that what at first seemed to be a very simple instrument is in reality most complicated. The rational grounds for it are by no means yet all worked out, but many of the earlier criticisms, favorable and

1. See especially the following:

Stern, W. *The Psychological Methods of Testing Intelligence*. Trans. by G. M. Whipple, Educational Psychology Monographs, No. 13, Warwick & York, Baltimore, 1914.

Terman, L. M., and others. *The Stanford Revision and Extension of the Binet-Simon Scale for Measuring Intelligence*. Educational Psychology Monographs, No. 18, Warwick & York, Baltimore, 1917.

———. *Psychological Principles underlying the Binet-Simon Scale and Some Practical Considerations for its Correct Use*. J. Psycho-Asthenics, 1912.

Pintner, R., and Paterson, D. C. *A Scale of Performance Tests*. D. Appleton and Co., New York, 1917.

Bobertag, O. *Ueber Intelligenzprüfungen (nach der Methode von Binet und Simon)*. Zeitschr. f. angew. Psychol. 1911, and 1912.

———. *Quelques Reflexions methodologiques a propos de l'echelle metrique de l'intelligence de Binet-Simon*. L'Annee Psychologique, 1912.

Kuhlmann, F. *The Present Status of the Binet-Simon Tests of Intelligence of Children*. J. Psycho-Asthenics, 1912.

———. *Degree of Mental Deficiency in Children as Expressed by the Relation of Age to Mental Age*. J. Psycho-Asthenics, 1913.

unfavorable, are now, in the light of a better understanding of the scale, seen to be unfounded, or irrelevant. A partial knowledge of these principles has also led to much constructive work now expressed in several different revisions of the original scale, and in a few attempts to offer substitutes and supplementary tests. Further work need not be entirely empirical, but may be guided by the knowledge of some fundamental requirements, the strict observance of which will be labor saving and lead to a more rapid progress than has heretofore been possible. These will be discussed under the following headings: (1) Requirements of the individual test. (2) The construction of a year scale. (3) The establishment of norms.

Requirements of the Individual Test. The now very extensive experience with the tests of the Binet-Simon scale has brought to the foreground certain essential traits that a test must possess in order to be entirely satisfactory and free from objection. It should be noted at the outset that few, if any, tests now in use embody all these essentials. Practically every test is a compromise, but all can now in a measure be judged beforehand in the light of past experience.

Objectivity. The first among the several requirements to be enumerated is objectivity. The test must be of such a nature that different persons using it will get the same results with it when other conditions are the same. The personal factor of the examiner may be noted as one of the chief disturbing elements that differentiates the mental measurement from the physical. It is therefore one of the first things that calls for control and elimination as far as possible. Binet warned against this. He cautions his readers against regarding his scale as an automatic measuring machine, and requires that the user should have a considerable training in psychology and

pedagogy, and that for such trained examiner much is left to his judgment in making a diagnosis.¹ Since the Binet Scale came into use the chief source of opposition has been the objections to the untrained examiner, rather than to other shortcomings of the scale itself. The fault has been very largely remedied in later revisions of the scale, for the original was hopelessly incomplete in directions for its use, which have now been supplied.² But much remains yet to be done. To make a test entirely objective in its administration, directions for giving it and for scoring responses must be complete and easily followed in all cases. The test itself must be of such a nature as to allow of a simple and brief statement of what the child is to do, that will not call for variation or repetition in ways that must be left to the examiner's judgment. It must also be inherently interesting to the child or such that a sufficient motive for maximum effort can be readily established by the examiner, for the latter must control the child as well as give the tests. Completeness of instruction to the child eliminates unforeseen ways of misunderstanding the task set and the necessity of corrections and supplementary explanations. Brevity of statement is required to insure attention. To listen attentively to lengthy instructions is itself a very difficult task for children, in which they very readily fail. To secure both completeness and brevity it is necessary often to break up the directions into several steps, and have the child perform the total task in corresponding steps.

1. See Binet, A. and Simon, Th. *The Development of Intelligence of children*. Trans. by Elizabeth S. Kite. Publication of the Training School at Vineland, New Jersey, Department of Research. No. 11, 1916, p. 239.

2. See Kuhlmann, F. *A Revision of the Binet-Simon System for Measuring the Intelligence of Children*. J. Psycho-Asthenics. Monogr. Suppl., 1912.
Terman, L. M. *The Measurement of Intelligence*. Houghton, Mifflin Co., 1916.

In scoring the responses to a test there is more occasion for the personal factor of the examiner's judgment to enter than there is in giving the test. Tests should be of such a nature as to eliminate this. The most effective way is to choose tests that require a time and error score only or one of these alone. Here the scoring reduces itself to counting the number of errors made, and taking the time with a stop-watch. When a great variety of responses to a test is possible, such as with definitions of words, or when the performance may be one of many grades, such as drawing a square, uniformity of scoring may be enhanced by describing and classifying the different grades of responses, giving copious illustrations under each class. But this procedure is at best an incomplete remedy. In the original Binet-Simon scale fully a third of the tests were more or less affected by this difficulty in scoring responses. In different revisions of it many new tests have been introduced that are equally at fault in this respect. In the scale of tests of the present writer every effort has been made to reduce this factor. The large number of new tests introduced that score directly in terms of time and error will indicate the importance given to this matter. Many otherwise good tests have been suggested and used by different examiners. It is not always possible to decide between a relatively poor test with a time and error score only and a good test that has the one fault of difficulty of scoring responses uniformly. Much also depends on the amount of special training and experience with the tests that is presupposed on the part of the examiner. None is required to score in terms of time and error. On the other hand, no amount of it will entirely eliminate the personal factor in scoring the other kind of test.

Discriminative Capacity. The one fundamental requirement of the individual test is discriminative

capacity. Most of the other traits to be discussed are directly or indirectly means to this end. By discriminative capacity is meant the ability to distinguish with it between different amounts of mental development. If the test is such that the responses to it can be scored only as passes or as failures, and are not gradable into a series of increasing scores, its discriminative capacity is measured by the increase in the percentage of average children from one age to the next that pass it. If it is of the type that yields a series of scores, such as a time and error score that improves with age, its discriminative capacity can in addition to the former method be measured also by the percent improvement in this score from one age to the next. It is granted that the discriminative capacity of any individual test can in no case be absolute, unless the two amounts of mental development, that is, the two ages to be discriminated with it are very different. In other words, not all the children of one age would pass any test and all children of the next lower age fail in it. In place of this we have only a certain increase in the percentage of children of one age passing it over the percentage of children a year younger that pass it. This discriminative capacity for any two consecutive ages depends on other things besides the nature of the test itself. Two of these need to be noted at this point. The first is age, and probably results mostly from the fact that younger children develop faster than older. According to this, the increase in the percentage of children passing a test from one age to the next is the higher the younger the children. For very young children an increase of thirty percent is not uncommon. For children approaching mental maturity a five percent increase is a good average. The change in this increase from younger to older children seems to be gradual. It should, of course, follow very closely the change in the rate of mental development which determines the decreasing

amount of mental development during a year with increasing age. The second factor on which discriminative capacity depends is the degree of difficulty the task in the test presents. In general, relatively difficult tests give a greater increase in percent passing of children of a next higher age than do relatively easy tests. Or, to refer it to the kind of test that allows a series of scores, the improvement in the score from one age to the next is large for the younger children and decreases as the test is applied to older and still older children. In considering these facts it must be remembered, of course, that degree of difficulty of a test is itself measured by what children of different ages can do with it. The increase for the older children is relatively small because the test is for them relatively easy.

The degree of discriminative capacity that must be required of a test in order to be regarded as satisfactory depends on the scale of tests of which it is a part, and is directly proportional to the total number of tests in the scale. The more numerous the tests the less discriminative each individual test needs to be. In the year scale it is also naturally higher the lower down in the scale the test is located. A relatively very small number of tests each of which has a high discriminative capacity may yield as accurate results in mental measurement as would a much larger number of tests each of which has a lower discriminative capacity. The exact mathematical relationships involved here have not yet been worked out. Conditions are so complex as to make this task very difficult, if not impossible. In the practical work of devising tests and constructing a scale the achievements have always fallen considerably short of the ideals aimed at in this matter of the percentage of children of given ages that pass each test at different points in the scale.

Method of Scoring. The method of scoring the individual test always needs careful consideration. It should be so scored as to give it the greatest possible discriminative capacity. It may be noted that the different kinds of tests in actual use can be grouped into three classes, when only an error score is involved, to which a fourth class must be added which combines the time and error scores into one. These three classes are (1) tests of one trial only, and in which the response can be scored only as a complete failure or as a complete success; (2) tests giving several trials on the same task; (3) tests giving several trials of tasks not of the same degree of difficulty. Since tests of the first class can be scored only in one way they need not be considered further. For the second and third classes different procedures in scoring are evidently possible. Binet and Simon followed the general rule of giving a child the same amount of credit no matter whether he passed one, two, or three trials of the same task in a test. In repeating five numerals from memory, for instance, the child is given three trials with three different series of five numerals each. We may assume that these three series are of equal difficulty and are therefore, three trials on the same task. The child is scored a pass if he succeeds in one trial, and he gets no more credit if he succeeds in all three trials. This has seemed to some a wrong method of scoring a test.¹ It has been held that a child should receive more credit than another if he succeeds in more trials than another. We believe that the latter is, on the whole, a mistaken view. But granting its correctness for the moment, the question arises as to how much more credit a child shall be allowed for each additional trial in which he succeeds. To make

1. Yerkes, R. M.; Bridges, J. W., and Hardwick, Rose. *A Point Scale for Measuring Mental Ability*. Warwick and York, Baltimore, 1915.

A number of writers have since expressed their preference for the "Point Scale" method of scoring.

the credit directly proportional to the number of trials passed is not permissible. It would be quite wrong to give A twice the amount of credit in a test as B because he passed in twice as many trials. Such a procedure would prove to be incorrect even when the different trials are not of the same degree of difficulty and represent virtually a graded series of different tests. Suppose B, for example, to be just unable to repeat five numerals. It would not matter much how many trials he were given; he would fail in all if he were really incapable of performing this task. Suppose A, on the other hand, to be just capable of repeating five numerals. It would not matter how many trials he were given; he would pass in most and fail only as his effort or other condition varied, for what he can do once he can do again, and any number of times. In this case the real difference in the abilities of A and B is very small, but the difference in the scores they would get would be limited only by the number of trials given A. The Binet-Simon method of scoring this kind of a test is undoubtedly on the whole correct. Success in one trial proves the child's ability to perform the task involved. Repeated successes in the same task in further trials proves no more. Failure in one or more trials when there has been success in one or more shows rather that some disturbance has entered causing him to fail. Usually, and especially for young children, this means simply inattention and varying effort. While it is true that this is a trait of young children and should be measured by the tests, it should not be a factor in every test of this sort, lest too many of the tests measure one and the same trait. Possibly for older children that are approaching mental maturity the Binet-Simon method of scoring this kind of a test is not the best. The way to find out which method is best is to determine which method gives the test the greatest discriminative capacity. Arbitrarily allotting

more credit for more trials of the same task passed is wrong in principle.

The Binet-Simon scale included a few tests of the third class, and which were scored in the same way as those of the second. It is not so easy to justify in theory this method in this case. If the different trials really represent tasks of different degrees of difficulty, different amounts of credit should be allowed for them in scoring, or, what amounts to the same thing, the different trials should be treated as different tests. It is undoubtedly easier for children to name the coins of the smaller denominations than it is to name the larger, and easier to give the day of the week than the day of the month within three days of correct. If the tests are to be used in a year scale, the question really becomes that of whether or not these several parts of a test of this sort are different enough in degree of difficulty to separate them by as much as a year. If they are not, no serious disturbance of the scale can result by scoring this kind of test in the same way as the test of the preceding class. The best procedure must be determined empirically by finding out what method gives the test the greatest discriminative capacity.

The correct scoring of the test that uses both a time and error score involves more complex considerations, but can also be reduced to a very simple rule. In the first place it is necessary to combine the time and error scores into one score in order to use the result as that of a single test. Time scores are in themselves probably more a measure of the amount of effort and steadiness of attention than are error scores. Tests with time scores are therefore more applicable with older children approaching mental maturity than they are with younger children. Effort and attention are mental functions that develop relatively late, and different degrees of them are distinguishing traits of older children more than of

the younger. But the relative importance of the time and error score depends also directly on the nature of the test. For almost any age the time score is more important than the error score in some tests, while the reverse is true in other tests. Importance here is measured again by discriminative capacity. If the average time score improves more from one year to the next than does the error score then the time score is the more important. There are some tests, in fact, in which either the time or the error score will improve with increasing age of the children tested, while the other will remain constant or even become poorer with increasing age. There are some tasks, for instance, in which older children naturally tend to exercise greater care, thus making much less errors, but at so great an expense of time that the time score becomes actually poorer. On the other hand, there are tasks in which the number of errors likely to be made is related directly to speed of performance. At a certain stage, for a certain age, the task becomes easy enough to perform somehow at a great increase of speed, but this increase in speed involves a disproportionate number of errors. There are practice stages in many complex tasks of skill, typewriting for example, in which the possible increase in speed is more than counterbalanced by the number of errors made. When applied to tests for children of different ages this sometimes results in the error score becoming poorer instead of better with the older children. The first requirement of a test with both a time and an error score is that both scores improve with age, or at least that one improve and the other remain constant. Tests that do not meet this requirement must be eliminated. The next thing to do is to determine which score, time or error, by itself gives the test the greater discriminative capacity, and how much. This done, a formula for combining the two scores should be so constructed that each score

counts in the combined time and error score in proportion to its discriminative capacity. To do this involves still another adjustment. It is usually more convenient to score the time in terms of seconds rather than minutes. A time score may therefore be, for example, 100 while the error score is 10. If the time and error score are to count for the same evidently the formula must take a multiple of one or the other score in place of the absolute figure. In the case given a convenient form would be $\frac{T}{10} + E$. If in this test, however, it was found that the error score alone gave the test twice the discriminative capacity that the time score alone did, the formula might be $\frac{T}{20} + E$, or $T + 20 E$.

Independence of Training. Among the criticisms against the Binet-Simon tests none has been made oftener than that they are too dependent on training; that they measure too much the amount of training the child may or may not have had in the particular tasks involved in the tests, and not his real mental development. It has been made a requirement of a good test that it be independent of training. The real facts involved here have been difficult to unravel. It has not been clear as to what is to be meant by "dependence on training." Taken literally, all tests are and must be dependent on training. There is no mental development without mental content, and no motor ability without motor training. Also, for the child to understand the examiner when he tells him what to do in a test, and to respond in words or acts requires mental and motor activities that have been acquired by training. Instead of being independent of training in this sense, all tests can aim simply to determine the effects of training and no more. But according to the capacities of different children these effects are much or little, and thus the tests come to measure these capacities, capacity here being simply another term for

intelligence. The requirement, therefore, cannot be independence of training, but only independence of a widely variable training. Tests that determine directly the effect of a particular kind of training may still be good tests if the tasks involved are such that all children have had the same amount of training in them. This results in three kinds of tests to which the criticism of dependence on training does not apply. The first consists of tasks which all children have had sufficient opportunity to learn to do, and can or cannot do according to their capacity to learn. The second consists of tasks which no children have had sufficient opportunity to learn to do merely through practice. The third consists of tasks that are of such a nature that attempts to learn to do them, practice, does not materially affect the ability to do them. The last kind alone could in any sense be regarded as independent of training, when by training a special training is meant. Tests belonging to the first class apply chiefly to young children, and hardly at all to older children. There are many things which all children must learn to do while young, and have sufficient opportunity to learn and will learn if they can. All must learn to use the sense organs, and muscles, to walk, talk, feed, and clothe themselves, recognize and learn the use of things found in every household, and so on. The degree in which any child fails to acquire these things is a measure of his inability to learn. As children become older their abilities become more specialized. There remain fewer tasks for them to learn to do that are common to all, and the measurement of their mental development becomes dependent more on the other kinds of tests.

It has been found impossible to determine by inspection and *a priori* analysis alone whether a test is unduly influenced by special training or lack of it with different children. There has been the greatest lack of agreement

among critics as to which tests belong to this class and which do not, because their views have been based only on such inspection and analysis. The question must be determined in each case chiefly by the results in the test given. If these are satisfactory, as judged by all the criteria of tests, the presumption is against the test being influenced by variable training. A good method is to group the children already examined into bright and dull as found by all the tests, and then determine how well the results of the particular test in question agree with this grouping of the children. Discriminative capacity of the test as indicated alone by the percentage of children of different ages passing the test is not in itself an infallible guide. Certain tasks are taught children more or less regularly at given ages, and the ability or inability to do them may not in any case be an indication of mental development. If any very large number of children were examined with a test involving such a task it would follow naturally that an increasing percentage of the children would pass it in going from younger to older, because to the very young it would have been taught least frequently and to the older more frequently.

Communicability. Closely related to dependence on training is the communicability of the test. If a test can be easily remembered by a child to whom it has been given, he may communicate it to other children who may then come to the examination prepared to pass it. To make this possible the task and the directions for doing it must, of course, be simple, easily remembered, and must not involve materials or conditions that the children cannot themselves supply. It affects only the second of the three kinds of tests mentioned above. It is necessary also, of course, that the child communicating it must have passed it and communicate the correct answer, which the other children then accept and repeat in their examination without knowing themselves

whether it is right or wrong; otherwise the communication would not affect the results. If the child fails he cannot communicate the correct answer, for he is but very rarely told by the examiner when he is wrong. If the children to whom the task is communicated can themselves correct the wrong answer communicated they would also have passed the test without having heard of it before. The ability to communicate a test correctly, after having been given it once together with twenty to forty others, itself requires a degree of mental development found only in older children. It is found but very rarely below a mental age of ten with any of the tests now in use. Thus limited, there are two circumstances which make it important that a test of the kind in question be of such a nature that it will not be easy to communicate. The first is the close association of children in large groups all of whom are being examined by one examiner, thus allowing plenty of time for knowledge of the tests to spread and be discussed. The reformatory group is the chief one of such groups where tests are being used. The next are classes in the public schools, and small private and special schools. The second is the dissemination of knowledge about such tests through newspapers and popular magazines. In the long run some of the tests may become more or less common knowledge with parents and older children because of the inability of these agencies to refrain from bringing them before the general public. The latter circumstance is merely a possibility in the future. The former has been met in the use of the older tests and has in a small measure affected the general results. Barring systematic effort made by a parent or other person to teach a child to pass these tests, communicability of tests is not a serious source of disturbance.

Variety. Another requirement of the individual test is variety. The Binet-Simon scale abandoned the attempt

to find tests that would measure the individual mental functions separately. If tests could be found that would measure these functions separately the requirement would be that the tests measure all the mental functions at each stage of mental development in proportion to their importance for general mental development. In place of such tests we have others devised without any reference to what mental functions they test. We do not know just what the tests are tests of, or at least we know it very incompletely in these terms. This incomplete knowledge, in part, is the basis for securing variety, but the variety of the tasks viewed from an objective standpoint is the chief guide. If the tasks themselves are varied in this way there is little chance that many of them will involve essentially the same mental functions, and thus not really be different tests. To multiply tests that are the same in character is of course of no value. To make a scale of such tests theoretically complete it would be better to have only tests that gave a series of gradable scores with children of different ages, and then score each test for as many ages as gave an improved score. The score any child would then receive in such a test would represent that child's development in the particular task involved, instead of showing simply that his development in this line was equal to or not equal to that of the particular age alone for which the tests are used. But there are difficulties which have prevented following this method in practice. The chief one is that we cannot limit ourselves to tests that can be scored in this way and have enough tests left for the lower ages. For the upper ages it has been possible. However, it involves the danger of limiting the tests to certain mental traits only to the exclusion of tests on later appearing traits. In the construction of a practical scale one has to take into account the number of tests any method would result in, the time it takes to give them, how it would

affect the scale as a whole, and the method of scoring. The result is a compromise between several conflicting factors.

THE CONSTRUCTION OF A YEAR SCALE

Mental development of children is so rapid that no mental test is really applicable over a range of more than several years of development. If a test is such that the average six-year-old, for example, can just pass it, it is not applicable many years below or above six because it would be obviously too difficult for the younger and obviously too easy for the older. If in any group of tests there are some which in this way fit each age the possibility of constructing a year scale with them is given. The only essential is that we know how many of these tests the average child of each age will pass. To determine the mental age of any given child it would be necessary then only to give him all the tests and note how many of them he passed. This number of tests passed would correspond more or less closely to the number average children of the same age passed, and this age would be the mental age of the child in question. But to give each child whose mental age is to be found all of a hundred and more tests would be highly impractical and absurd as well, considering the nature of the tests that are required for a complete scale covering the whole range of mental development. There would be no point to giving a six-year-old child two-year-old or twelve-year-old tests. In fact, it would be decidedly detrimental to the child's attitude and effort in the tests to give him any that were either much too easy or much too difficult for him.

Arrangement of the tests in Age-Groups. The grouping of the tests into different age-groups naturally suggests itself, which means that certain of the tests will be grouped together as six-year-old tests, others as seven-year-old tests, and so on. The great practical advantage

of such age grouping is at once obvious. It does away with the necessity of giving more than a small portion of all the tests in the scale. Something is always known about a child's mentality before he is examined, and this knowledge is sufficient to indicate with what age-group of tests to begin his examination. The procedure in determining the mental age is equally simple. The child is given the tests of successive age-groups in both directions until an age-group at the lower end is found in which all the tests are passed and another age-group at the upper end in which none of the tests are passed. This done, we can assume that the child can pass all the tests in the still lower age-groups which were not given, and that he cannot pass any of the tests in the still higher age-groups that were not given. This then gives the total number of tests that he can pass in the whole scale. If all the tests were simply arranged in the order of difficulty from first to last, without referring any of them to any special age, the same might at first thought seem to be accomplished. In this case one would come to know that the examination of a six-year mentality should begin with, say, test number fifteen, that in examining a seven-year-old child one might begin with test twenty-two, and so on. It would also be found that in going downward in the scale one could stop after the child passed a certain number of tests successively without any failure, and that in going up in the scale one could stop after the child had failed in a certain number of tests successively without passing in any. But the determination of these points for all cases would amount virtually to an arrangement of tests into age-groups. The determination of the different degrees of difficulty of the different tests would in the first place, of course, imply relating them to the average abilities of children of different ages to pass them.

Determination of Mental Age from the Tests Passed.
When the tests are arranged in age-groups practically

no child examined with them will stop passing the tests abruptly in any age-group, so that he would have passed in all tests up to a certain age-group and have failed in all in age-groups beyond this. In place of this he will pass all up to a certain age-group and then fail in an increasing number of each age-group until one is reached in which he passes none. The age-grouping of the tests calls for some method of counting these extra, scattering tests that are passed in determining the exact mental age. A simple method would be to base this determination on the total number of tests in the whole scale that are passed without reference to the age-groups in which the passed tests are located. Thus, if the average six-year-old child passed thirty of all the tests, any given child passing that many would have a mental age of six, no matter how the passed tests were distributed over different age-groups. This method has never been followed. An equally simple method is possible when the number of tests is the same in all age-groups. If this number is five, for example, the child is given one year in mental age for every five tests he passes beyond the age-group in which he passes all and below which he passes all. This has been essentially the rule in all the revisions of the Binet-Simon tests, including the authors' own revision in 1912. When the tests are not the same in number in the different age-groups an additional difficulty arises when the attempt is made as is now the universal custom, to count fractions of a year in the mental age. If there are five tests in each age-group the passed tests left over may be counted as fifths in the mental age, but if the number is unequal no satisfactory procedure is possible. It has been suggested that in that case each such test should count in proportion to the number of

tests in its age-group.¹ The extra tests passed in an age-group of four tests should count as fourths; in an age-group of seven tests they should count as sevenths, and so on. This procedure has two serious objections. Counting up several fractions of different denominations would be an awkward process from the practical standpoint. From the theoretical standpoint, there is no reason why a test should count for more simply because there happened to be less of them in its age-group. The same difficulty would, of course, still exist if the determination of the mental age were based directly on the total number of tests passed in the scale without reference to their age-groups, unless the increase in the average total number passed from one age to the next were the same throughout the scale. If the latter were the case the scale would fall into age-groups with an equal number of tests.

In counting these extra, scattered, tests passed in the way suggested here the objection has been made that it should make a difference in the score a child received as to whether he stopped abruptly or failed gradually in going up the scale.² Let us assume two cases examined with a scale that has five tests in each age-group. Suppose that A passed all tests in age-groups VII and below this and passed none in VIII and beyond, giving him a mental age of just seven. Suppose B passed all in VI and below, three in VII, two in VIII, and none beyond this, giving him also a mental age of just seven. It is argued that B should have a slightly higher score than A because a passed test should count for more the more difficult it is, and B passes two tests in VIII where A

1. Terman, L. M., and Childs, H. G. *A Tentative Revision and Extension of the Binet-Simon Measuring Scale of Intelligence*. J. Educat. Psychol., 1912. Pintner, R. and Paterson, D. G. *A Scale of Performance Tests*. D. Appleton and Co., New York, 1917, p. 144.

Terman in his later revision gave up this method, and uses six tests in each age-group. Where he has more than six tests the extra ones are used as alternates only.

2. This was first suggested by Stern. See p. 106 of reference cited above.

passes none. This argument, however, takes account of only one part of the fact of scattered passes, and ignores the other. If scattering means passing relatively high and difficult tests it means equally failing in relatively easy tests that are low in the scale. If, in the illustration given, B should be allowed special credit for having passed the two tests in VIII, he should in equal degree lose credit for failing in two of the tests in VII which A passes.

The main conclusion that these considerations lead to is that in the construction of a year scale the arrangement of the tests into successive age-groups with the same number of tests in each has several advantages over no arrangement at all and also over the arrangement of the tests in the order of difficulty from first to last, without any further definite reference of any test to any special age. The age-grouping is, theoretically, not a necessity, but in its use it is a very great convenience, and all but a practical necessity.

Correct Placement of Tests in the Scale. The next question is how the tests shall be grouped so that the scale will give correct mental ages. This question divides itself into three distinct inquiries. The first is that of average accuracy. This is determined by finding how closely the average mental age of a large number of six-year-olds, for example, approximates six years, and the same for every other age from birth to mental maturity. The second is that of frequency of error in the individual mental age as given by the scale. The third is range of error in the individual mental age as given by the scale.¹

It is a relatively easy matter to arrange the tests in a year scale so that the average mental age of any group of children examined will very closely approximate abso-

1. These three questions are discussed at length in my article on the results of examining one thousand public school children, see reference below.

lute accuracy. The original scale of the authors measured considerably too high for the lower ages and too low for the higher ages, being approximately correct only in its middle portion.² But successive revisions of it by different investigators have each helped to correct this general tendency, until now it may be said that this fault has been removed in an entirely satisfactory manner, for most parts of the scale. It has required shifting a number of tests into different age-groups, dropping some out entirely, and adding some new ones in place of the old. Where it is desired to know only the average mentality of a large group of individuals the present scale leaves but little to be desired as regards accuracy. A number of different groups of children and adults have been compared by the use of the old scale that has resulted in most valuable information for the securing of which these tests have furnished the only possible method. Among these have been juvenile delinquents in general, reformatory inmates, adult criminals of prisons, prostitutes, tramps, paupers, negroes, pedagogically retarded children of the public schools, special class children of the public schools, children of schools for cripples, epileptics, and inmates of institutions for the feeble-minded. The scale is equally applicable to any other group.

In the great majority of instances the interest is not in the average mentality of a group, but rather in the mentality of the individual. The last two questions are therefore of more importance than the first. It is more

2. Various studies have contributed to bringing out this general fact. See especially the following:

Terman, L. M., and Childs, H. G. *A Tentative Revision and Extension of the Binet-Simon Measuring Scale of Intelligence*. J. Educat. Psychol., 1912.

Terman, L. M., and others. *The Stanford Revision and Extension of the Binet-Simon Scale for Measuring Intelligence, Educational Psychology Monographs*, No. 18. Warwick and York, Baltimore, 1917.

Goddard, H. H. *Two Thousand Normal Children Measured by the Binet Measuring Scale of Intelligence*. Ped. Sem., 1911.

Kuhlmann, F. *The Results of One Thousand Public School Children Examined with a Revision of the Binet-Simon Tests of Intelligence*. J. Psycho-Asthenics, 1914.

important that a scale be so constructed that errors in the individual mental ages do not occur very frequently, than it is to have a scale that on the average gives exactly correct results. And again, it is more important to have the possible range of errors small than simply to have them occur relatively infrequently. The chief desideratum is the certainty that the largest possible error be known to be small. In examining any given child there is usually no means of knowing whether the scale is in this particular case making the maximum error or no error at all. Knowledge of the exact degree of probability of a certain amount of error, such as a mathematical treatment of statistical results with the tests gives us, is of value, but still unsatisfactory in the classification of the individual case.

In connection with the original scale and earlier revisions the attempt has been made to show what the frequency and range of error with the scale are.¹ This has been done with the aid of certain assumptions concerning the normal distribution of different grades of intelligence of unselected children. These assumptions are that the true distribution curve is symmetrical, and that the majority of children have an average intelligence. The procedure in determining the degree of accuracy of the scale was then to examine a large number of children and plot a distribution curve based on the number of children that passed the tests at age, and the number that were retarded or advanced by one, two, three years, and so on. In this way it was found that, roughly, the distribution curve as given by the tests was symmetrical, about the same number were retarded as advanced, and approximately a majority passed the tests at age, counting a child passing at age when he was

1. See Binet and Simon's article on their 1908 scale, translated by Elizabeth Kite in Binet and Simon, *The Development of Intelligence in Children*. Publications of the Training School at Vineland, New Jersey, No. 11, 1916. Also Goddard, H. H., *Two Thousand Normal Children Measured*, etc., in *Ped. Sem.*, 1911.

retarded or advanced by less than a year. The conclusion was that this proves the accuracy of the scale. But there are several things about these assumptions and the method of procedure that are unsatisfactory, and these results really prove nothing about the range and frequency of errors to which the scale is subject, that was not already granted on the basis of other observations. Three of these may be noted. The first is that the nature of the true distribution curve for different grades of intelligence is not known in more than its general outline. The assumption that it is symmetrical is probably not correct. There are probably more children retarded in mental development than there are cases that are above the average in mental development. It is certain that the range of retardation is greater than the range of advancement, and it is more than likely that a greater frequency of the retarded follows from this. The second is that the assumption as to the majority of children being of average intelligence is quite too indefinite and inapplicable in the method of proof used. This majority might constitute fifty-one percent of all children or it might be ninety-eight percent. If a scale of tests made fifty-one percent pass at age, while seventy-five percent or more were really of average intelligence, it would be of no value at all as a measuring instrument. For such results to show anything about the accuracy of the tests the exact proportion of the children that are of average intelligence must be known more definitely. The third fault lies in the fact that nothing is said or known about what range this average intelligence is to include, and that the corresponding procedure of classifying a child as passing at age in the tests when his mental age is within one whole year of his chronological age is entirely arbitrary. The exact average of any group may be a mathematical point to which none belong, or, if the whole group is divided into three grades only, it may include a third of

the whole range of variation from lowest to highest. Again, any proportion of all children can be made to pass at age with these tests, depending on how the term "at age" is defined and used. From the fact that the rate of mental development decreases with age it follows also that it cannot be defined in the same way for all ages. If at age is taken to mean less than one year of variation in mental age from the chronological age then the proportion of children that pass at age must necessarily decrease very much with the age of the children considered. For a year of retardation or advancement means the more variation the younger the child. Even if this rate of normal development were constant from year to year a retarded or accelerated rate for a given child would mean an increasing amount of difference between age and mental age with increase in age, which would also result in a decreasing proportion of all children passing at age with increasing age of the children.

In the present situation it should be acknowledged frankly that we do not have, as yet, an exact knowledge of how frequently the mental age as determined by these tests is wrong or what the greatest error that they ever make is. For any ready determination of these two questions it is required that we know beforehand what the exact mental ages are of a large number of children of different ages on whom the tests might then be tried to see if the results agreed with the facts. But it is just the lack of any method by which this knowledge of exact mental age can be obtained that the tests themselves aim to supply.¹ Possibly a mathematical method of treating the

1. The attitude of many is that we can know the exact grade of intelligence of a child by extended observation and by combining all the ordinary sources of information. Thus the most common procedure with many is to judge the accuracy of the tests by how well their results agree with pre-established opinions. If the tests happen to agree with these opinions they are judged accurate; if not, the tests are judged to be at fault. The absolute untrustworthiness of even the most carefully formed opinions of this sort can be easily demonstrated by having several observers each give his opinion on the same children. There will be no agreement where at all small differences in grades of intelligence are in question.

test results can be found that will give us the desired information, but, so far, none has been worked out. For the present the construction of a year scale of tests must observe three facts, all of which will tend to increase the reliability of the mental age of any particular child, as found by the tests, but it will not give us any knowledge of the exact degree of reliability at any point. Two of these have already been considered. They are, first, agreement of average mental age of a group of children with their average chronological age; second, the largest possible discriminative capacity of each individual test in the scale; third, increase in the total number of individual tests in the scale. Practical considerations largely determine the total number of tests that can be used. The time it takes to give them sets the limit in number. A point is also reached soon where the mere increase in number is not further justified by the increase in reliability that results. Fortunately the improvement in reliability by increase in number of tests can be computed exactly by proper mathematical treatment of the results and their comparison when two, three, four, or more tests in each age-group are used in obtaining the mental age.²

The Percentage of Children that Pass a Test when Correctly Placed. The arrangement of the tests into different age groups so that the average mental ages of children of any given chronological age will closely correspond to the latter requires some criterion that will show in what age-group a given test belongs. This criterion is the different degrees of difficulty children of different ages have in passing it. This degree of difficulty is in turn measured by the percentage of children of an age in question that pass it. The question thus arises as to what percentage of, say six-year-old children, should pass a test in order for that test to be correctly placed in age-group VI. The answers to this question have been

2. See Doll, E. A. *A Brief Binet-Simon Scale*. Psychological Clinic, 1918.

various. Binet and Simon did not discuss it directly, but from different incidental statements indicate that they have varied it from sixty to ninety percent. Others have proposed seventy-five percent, sixty-six percent, and fifty percent.¹ A careful study of all the factors involved shows that this percentage is dependent on a number of different conditions, which results in its not being the same for all age-groups. In the present revised and extended scale of eight tests per age-group covering all ages from three months to mental maturity this percentage ranges from nearly a hundred percent at the lower end of the scale to about fifty percent at the upper end. This is the fact found empirically. In the construction of this scale the tests were provisionally placed in certain age-groups, and then shifted about so that the scale would give correct mental ages at each point. The explanation for this fact that the percentage that should pass a test decreases in going from one age-group to the next higher is to be found in the increasing number of scattered passes for any child with increasing mental age. The results of the tests show that the total number of tests that a child passes beyond the highest age-group in which he passes all increases regularly and very materially with increasing mental age. For the very lowest mental ages the scattered passes very frequently are limited to one age-group. For the highest mental ages the scattered passes very frequently extend over five or six age-groups. Scattered passes are in turn the result chiefly of two factors, the decreasing rate of mental development of children as they grow older, and the discriminative capacity

1. Goddard, Huey, Bobertag, Pintner and Patterson, and others proposed seventy-five percent. My 1912 revision followed the earlier suggestions. Terman and Childs in their tentative revision suggest sixty-six percent as more nearly correct. In Terman's later revision of the tests no definite percentage is proposed. In the analysis of my results on normal children with my 1912 revision, I conclude that on the whole sixty percent is about correct, but point out that it must vary with different age-groups, decreasing gradually with higher age-groups. Later, Otis, from purely mathematical deductions, concluded that fifty percent is correct for all age-groups. See his article on *Some Logical Aspects of the Binet-Simon Scale*. Psych. Rev., March and June, 1916.

of the individual test. The following illustration will serve to make clear the main point in question here. Assume a scale of tests with five tests for each age-group, beginning with age-group I. Assume a hundred average six-year-old children examined with the tests of this scale. For the tests to be correctly placed in their respective age-groups requires then that the average mental age of these one hundred children shall be just six years as given by the scale. Assume two degrees of scattering in the number of extra tests passed beyond the age-group in which all are passed, as follows:

| Age-groups | I | II | III | IV | V | VI | VII | VIII | IX |
|--------------------------|-----|-----|-----|-----|-----|-----|-----|------|----|
| Total number passes..... | 500 | 500 | 500 | 500 | 400 | 300 | 200 | 100 | 0 |
| Total number passes..... | 500 | 500 | 500 | 500 | 500 | 400 | 100 | 0 | 0 |

The total number of passes here for the one hundred children is 100×5 for each age-group where all tests are passed. In the first case there is considerable scattering of passed tests for these one hundred children. All pass all tests up to and including five tests of age-group IV. In V, with a total of 400 passes, only 80 percent of the children on the average pass each of the five tests. For VI it is 60 percent, for VII 40 percent, for VIII 20 percent, and for IX none. On the whole they get 3000 passes, which gives them the required average mental age of just six years. In the second case there are but few scattered passes. All of the one hundred children pass all of the five tests in each age-group up to and including age-group V. In age-group VI there are 400 passes, in VII, 100 passes, and none beyond this. In this case the percentage of the children that pass the tests of each age-group is 100 for each age-group up to V, inclusive, 80 percent in VI, 20 percent in VII, and none beyond. The total number of passes is again 3000, giving the average mental age of six years. Thus, in

the first case a test would be correctly placed in age-group VI if 60 percent of average six-year old children passed it. In the second case, with less scattering of passed tests, a test would be correctly placed in age-group VI if 80 percent of average six-year-olds passed it.¹ In other words, when the scattering is greater this percentage must be smaller. It is difficult to determine mathematically what the exact percentage should be for each age-group, even when only the two factors noted are taken into account. It would be possible, with sufficient results at hand, to work out the decrease in rate of mental development from year to year, as given by the tests themselves. But it is very difficult to secure a number of tests that have even approximately the same discriminative capacity. The more practical procedure is to regard this question as of secondary importance, and to proceed empirically in the construction of the scale by shifting tests about until the scale gives correct mental ages. When this is done in an adequate manner the other problem as to the percentage that should pass a test is thereby solved automatically. On the other hand, it is of the greatest practical advantage to know at least approximately, what this percentage is, when the problem is simply that of revising or adding to a scale that is already constructed. New tests can thus be added to any age-group, or old ones replaced by new ones, simply by finding tests which children of the proper age pass with the required frequency.

Equality of Difficulty of Tests in an Age-Group. The discussion of this question may seem to have implied that all the tests of any given age-group must be of the same degree of difficulty. If sixty percent of ten-year-

1. A proper understanding of the facts in question here brings to light how irrelevant an earlier criticism of the Binet-Simon Scale, still often heard from laymen observers, was, viz., that certain tests in a given age-group must be poor because many older children are known to fail in them, or that many younger children are known to pass them. Thus it is still common criticism that many entirely normal adults even will often fail in an upper age test. The intended ridicule of the tests applies very well to the critic.

old children should pass any one test in age-group X, it should be the same for each of the other tests in this age-group. This, however, is not a necessity from a theoretical standpoint, and is always far from being realized in any actual scale of tests that has been produced. Theoretically, these percentages may vary from the ideally correct figure, provided they do so in equal amounts above and below, so that the average for all the tests in the age-group will be correct for the group. When the actual percentages are studied for the tests of different revisions and of the original scale it is seen at once that they may vary in a most remarkable degree from theoretical requirements without seriously disturbing the general accuracy of the results. This also explains the fact that the original scale gave relatively very good results even though it contained many tests that were misplaced, and required shifting into lower or higher age-groups. For a single test to be placed one age-group too high in the scale will by no means result in the scale always measuring one test too high. If a ten-year test were located in age-group XI, the scale would measure one test too high in only a certain percent of the cases examined, because the great majority of those who pass a ten-year test will also pass an eleven-year test. The percent of error the scale would make because of such a misplacement of a test would only equal the difference between the percentage of a given age that pass a ten and an eleven-year test. This is in the neighborhood of twenty percent. If another test of the same age-group were misplaced by the same amount but in the opposite direction the two resulting errors would cancel each other even in the examination of the individual case. The misplacement of a few tests does not affect the accuracy of the scale as seriously as it might seem, and if the misplacements are distributed in the right way the accuracy may not be affected at all.

THE ESTABLISHMENT OF NORMS

By definition, the mental ages represent the average mental development of children of corresponding chronological ages. Having outlined the general traits required of each individual test, and the general principles to be observed in combining the tests into an age scale, the very important problem of selecting children that will make scores with the tests that are truly representative, the average for all children, remains. This concerns the establishment of norms for the tests. A great many so-called mental tests have been and are still used for diagnostic purposes for which no established norms exist. The exact performances, the scores that average children of different ages make with them are not known. Users of such tests draw on their own imagination in determining the grades of intelligence, or levels of mental development that the different scores individual children are found to make with them represent. Such "tests" are not tests. They can serve no other purpose than to deceive, including often the author and examiner as well as the uninitiated outside observer. On the other hand, while it seems on first thought a simple matter to try out any tests on average children and determine what the normal scores for different ages are, this task has never been accomplished in a manner that is free from all objections. The ideal from a theoretical standpoint has not yet been even defined. It was at first claimed that the children to be used in the establishment of norms must be unselected children, including all children without any eliminations, otherwise a true average performance could not be established. But this ideal was soon found to be impractical. Of course not all children can be examined, but even a random sampling of all children is likewise impossible. Children are not available for the purpose of examination except in groups, such as in the schools, and institutions, and

in some other instances when some special factor brings them together temporarily for some specific purpose. Now the very fact that they are grouped for some purpose means that they are not entirely unselected. Norms for tests must, therefore, always be based on results obtained with selected children. The possible errors that might result from this can be corrected if the selective influences in each group are known so that the children tested for norms may be still further selected artificially in such a way as to counteract the influence of the selection inherent in the original group. But before we accept the truly unselected group as the ideal, let us consider whether it really is ideal. "All children" might include children of all races. If taken thus inclusively the unselected group would be highly undesirable. The Binet-Simon tests have already shown that there are marked race differences in rates of mental development and final levels reached.¹ A scale that gives correct mental ages for white children does not do so for negro or Indian children in America. White children of different nationalities seem to be fairly alike. The original Binet-Simon Scale adapted to French children seems on the whole to give about the same results when used on English, German, Russian, and Italian children. But the white children from different classes as determined by different social conditions differ more from each other² than

1. Report on the Mental Examination of Certain Pupils in the Thomas Indian School, Iroquois, N. Y. *Eugenics and Social Welfare Bulletin* No. 11. The Bureau of Analysis and Investigation. State Board of Charities, Albany, N. Y., 1917.

Morse, J. *A Comparison of White and Colored Children Measured by the Binet-Simon Scale of Intelligence*. *Pop. Sci. Mon.*, 1914.

Phillips, B. A. *The Binet Tests Applied to Colored Children*. *Psychol. Clinic*, 1914.

Rowe, E. C. *Five Hundred and Forty-Seven White and Two Hundred and Sixty-Eight Indian Children Tested by the Binet-Simon Tests*. *Ped. Sem.*, 1914.

Strong, A. C. *Three Hundred and Fifty White and Colored Children Measured by the Binet-Simon Measuring Scale of Intelligence; a Comparative Study*. *Ped. Sem.*, 1913.

2. See article by Strong.

Also Yerkes, R. M., Bridges, J. W., and Hardwick, R. S. *A Point Scale for Measuring Mental Ability*. Warwick and York, 1915.

Bridges, J. W., and Coler, L. *The Relation of Intelligence to Social Status*. *Psychol. Rev.*, 1917.

do the races so far examined with these tests. These general facts remind us once more that the year scale does not measure in absolute terms, but in terms, mental ages, that are relative to the average development of the kind of children on whose scores with the tests the norms are based. The inch scale applies equally to the physical measurement of children of all races. The year scale in mental measurement does not do so directly without some adjustments. It has been proposed that different scales be worked out for different races, and even for different social classes.¹ In my judgment this would lead to confusion and less practical applicability than a single scale used for all children. The most practical standard would seem to be the national, not that of the race or class. Each nation sets the requirements of its children, and all must meet them as best they can irrespective of race, or class. After all, the objections are more theoretical than practical. A scale that fits the average American white child is in every practical sense satisfactory. Where race and class differences exist it is not difficult to make the necessary adjustments in the results. Again, it is to be remembered that the very purpose of mental measurement is to show just such differences. If the average child of another race had an intelligence of only .95 as measured in terms of the white child's scale it is difficult to see any practical value of having another scale which would give this other child an intelligence of 100 instead of .95, unless the value for the two scales could be equated. If they were, thus equated there would be no particular advantage in having two scales in place of one.

Granting that unselected children are not available for examination purposes to establish norms for tests, we may consider the nature of the groups that are available and what influences on the average mental develop-

1. Proposed especially by Yerkes.

ment the selective factors may have had. These groups naturally divide themselves into three classes according to the age of the children. The first is the age of infancy including the first two years, the second is the kindergarten age from three to five, and the third the school age proper from six to mental maturity. For the first period three classes of children have been available; children in maternity hospitals, children brought to baby contests more or less common in the middle and western states, and children of orphan asylums. Probably neither of these three classes present a mental development that is truly representative of all children. Since children born in maternity hospitals usually leave after a very short period they can in any case not contribute much to norms. Children brought to baby contests are probably on the whole considerably above average. There are two selective factors at least that would tend to produce this result. In the first place, parents of the lower classes do not interest themselves in baby contests, probably usually do not know of them at all. In the second place, parents of the middle and upper classes probably exercise some judgment in bringing children to a contest; the better developed children are more likely to be brought. Orphan asylums usually have some children below three years. Their average mentality is undoubtedly below that of children in general. While not always orphans, these children come from a variety of parents all classes of which are on the whole undoubtedly below average. Parents that die young are below average physically, and on the average leave descendants that have inherited some defects that react on their mental development in some measure. Orphan asylum children that come from broken up homes, from parents who have separated, or who cannot or will not bring up their children can likewise not be regarded as representing average human stock. While we can reasonably assume that selective factors of this sort are present to make the

average orphan asylum child slightly below the average of children in general in mental development, it is not necessary to rely entirely on such analysis. Older orphan asylum children have been examined with the Binet-Simon tests, and on the whole have been found below average.¹ If this is true of the older orphan children it is surely also true of the younger.

The age period from three to five years is the most devoid of children available for testing to secure norms. The orphan asylums furnish a small number. The kindergartens constitute practically the only other group for this age. But little can be said positively about what mentality kindergarten children represent. According to locality, the kindergarten is often highly selective. The kindergarten class may contain predominantly children from the poorer homes where the mothers are employed or where for some other reason the parents take advantage of this opportunity to have the children taken care of during the day. My judgment is, however, that more usually it is the more intelligent parents of the middle and upper classes who appreciate the advantages of the kindergarten from the children's standpoint and thus send their children more frequently than do average parents.

Mental tests find their chief application with children of school age, and especially with children of the lower grades. It is for these ages, therefore, that it is especially desirable to secure norms for the tests that are as nearly representative of unselected children as possible. It was at first thought that taking all school children without any further selection would fulfill this condition in a satisfactory manner. My experience, however, has been that this is not true beyond the age of ten, and that

1. *Examination of Orphan Asylum Children*, Eugenics and Social Welfare Bulletin No. 11. The Bureau of Analysis and Investigation. State Board of Charities, Albany, N. Y., 1917.

Streeter, L. C. *Existing Conditions Relating to Defectives and Feeble-Minded in New Hampshire*. Report of New Hampshire Children's Commission, 1916.

it would be desirable to select the children even below this age instead of taking all that are in the schools without eliminations. It is well known that the schools themselves involve a selecting process. The very lowest grade children never enter the public schools. Higher grade defectives enter and remain a different number of years which is on the whole probably quite proportional to the degree of their deficiency. Thus the schools are not only selective but are increasingly so the older the children or the higher the school grade. Children with an intelligence as low as .30 may enter the kindergarten or first grade, but never get advanced and rarely remain over a year. Children with an intelligence of .70 to .80 are more or less frequently found in the eighth grade, and remain in the schools until the age of fifteen and over. The merely dull children who range between .80 and .90 may pass through all the grades and high schools, but usually at considerably retarded rates. The bright children with intelligences above 1.00 are in a far less degree pedagogically advanced in the grades than the dull are retarded.¹ Thus beyond the third school grade, about, a condition is soon reached where the children of any grade no longer represent an exact average of children in general. In the seventh grade and beyond the mental development is very likely to be distinctly inversely proportional to the ages of the children, the older children of a given grade having the lower mental ages instead of the higher. Thus it becomes entirely unpermissible to select children of two or three consecutive ages from one or two school grades only in attempting to secure norms for these ages. If it is intended to take unselected school children for any given age all the children of that age in the whole school system must be taken from all the school grades in which they are found. When this is done the average mental development of

1. See Terman, L. M. *The Measurement of Intelligence*. Houghton, Mifflin & Co., 1916.

the children for each age will still be slightly too high for the younger children and increasingly too high for the older children. This difference is due, of course, to the duller children dropping out of school with increasing frequency as they grow older and attempt to pass up through the successive school grades. For all practical purposes of securing norms the difference is probably negligible for children up to the age of ten. The average mental development of children from twelve to eighteen who still remain in school is probably appreciably above the average of children in general. Sufficient statistics are not yet available to determine whether this difference is enough to disturb seriously the norms for tests based on unselected school children. The following illustration based on Terman's results with 1000 unselected school children aged five to fourteen years may give some idea of the possible effect of the elimination from the schools of the duller children. In Terman's results .33 percent have an intelligence of .56 to .65; 2.3 percent have an intelligence from .66 to .75; 8.6 percent from .76 to .85. Assume a hundred children each with an intelligence of 1.00, giving them an average intelligence of 1.00. For three of these children substitute three others with an intelligence of .70 each. For ten more of these children, substitute ten others with an intelligence of .80 each. These thirteen children are about what it seems we may roughly suppose the schools to eliminate beyond about the seventh grade. The average intelligence of these 100 children drops from 1.00 to .97 by the substitution. A scale based on norms from children in the schools may measure several points higher at its upper end than would be the case if the norms were based on children in general, entirely unselected. Let us not conclude, however, that a scale based on norms from entirely unselected children would be more desirable than one which has eliminated a certain

percentage of the lowest grade cases in the establishment of its norms. The normal distribution curve for different grades of intelligence may not be symmetrical. As pointed out above in another connection, there are probably more children below average intelligence than above. If this is so some of the lowest grade cases should not enter in the establishment of norms for a scale of tests.

I am inclined to the opinion that in the establishment of norms only those children should be selected who are pedagogically normal. In actual practice it becomes necessary to do so for the higher ages, for the selective influences become so complicated and variable that it requires hundreds of cases of each age to secure reliable average scores if those influences are neglected. In accepting this method, however, a number of objections and difficulties, from a theoretical standpoint, still remain. In selecting pedagogically normal children only, the duller cases are not eliminated in the same degree for the different ages and school grades, but in an increasing degree as we go up in the school grades. On the whole those above average intelligence are not eliminated as much as those below, because the schools do not allow the brighter to advance ahead of their grade as much as they compel the duller to fall behind their grade. But, again, the brighter are eliminated in an increasing degree by this selection as we go up in the grades, because as the brighter children grow older more of them will skip a grade or more. Furthermore, in selecting the pedagogically normal children alone we assume that the work of the different school grades is at all points equally a means of measuring intelligence and that it is correctly adjusted to the capacities of children of different ages. Finally, the question remains as to how the pedagogically normal is to be defined. Most children are between six and seven when they begin

their first grade in September. This makes the average age of children at the beginning of the first grade near six and a half years. But testing children to establish norms for tests can usually not be all done in September. And six and a half years cannot be taken as the pedagogically normal for first grade children at all times of the school year. The time of the school year must be taken into account in defining the pedagogically normal age for each school grade.

If the schools themselves exercise a selective influence in determining the kind of children to be found in the different school grades, there are other larger selective influences which determine the kind of children in any community that are brought to the schools in the first place. General locality differences in the average grade of intelligence found in a given locality result from many different factors. The tendency often witnessed in this country of immigrants of a certain nationality or class settling and congregating in one district because of mutual personal bonds is one of these. The locality itself often possesses traits which attract or repel one class of people rather than another. The ambitious and capable move to localities where opportunities are largest. "The deserted New England farms," the "Poor white trash" of mountains of the South, the "Backwoodsman" of many localities, and "Young man, go West," are phrases based on a general recognition of this fact. Aside from the locality itself the predominant occupation of a locality which may be little or not at all related to physical traits of the locality, probably often exercises a marked influence on the average abilities of the population. Different trades call for different qualities of men and women.

Such locality differences, however, are sufficiently recognizable, and need not be a source of disturbance in establishing norms for mental tests. They need simply to be kept in mind and avoided. Differences likely to

exist in the population of different parts of large towns and cities require a more careful consideration, lest they be overlooked. Taken in the large, there is a relation between the price of real estate and the abilities of real estate owners. The weak, inefficient and incapable on the whole gravitate towards those sections of the town where real estate is cheap or where houses can be rented. It does not require a "slum district" of a large city to lower the average intelligence of the children inhabiting a given city area. Any town with a population of 10,000 or even less is likely to have a good and a bad section. The possible disturbance to norms due to these selective influences is again not difficult to avoid. But it is important and necessary to do so. If in any large city the children tested for norms were selected from a few schools only it is more than likely that their norms would deviate slightly from the true averages sought. All the schools in any given school system should be used in selecting the children. The number selected from each school should be the same percent of the school's total enrollment in each case.

One more question needs to be considered in connection with the establishment of norms. This is the question as to the number of children required to make the average scores obtained reliable. The possible influence of a number of disturbing factors has always, in a general way, been realized. The common method of meeting the difficulty has been to require large numbers, the idea being that if only enough children were tested the influences of opposing factors would cancel each other and leave the average undisturbed. But there is a fallacy in this method. The disturbing influences may not be opposing influences and the increase in numbers, merely, may not avoid the difficulty. An analysis of conditions leading to a knowledge of what the disturbing influences are, and a consequent selection of the children so as to avoid or counteract them is a much more effective

method than multiplying numbers without such analysis. This being granted, the number of children tested in the first place must be viewed from the standpoint of their distribution over the different ages. A thousand cases is an ample number for the construction of a complete scale of tests if there is approximately an equal number for each age. If all the children of a school system, however, are taken, or if they are so selected that the same percentage of each grade is taken the distribution will be very poor, giving three to four times as many with an age of six and seven as with an age of fourteen and fifteen. For this reason the large number of children on which the norms for a whole scale are based is sometimes misleading. This number may be very small and inadequate for some ages, most likely the ages below six and above twelve. In the second place in order really to determine the discriminative capacity of a test, it must be given to children of a minimum of three consecutive ages, the middle age being the age corresponding to that of the age-group of tests in which the test in question is to be placed. But since this middle age is not known beforehand it is usually necessary to give a test to children of several consecutive ages in order to find the three ages for which average scores are to be established. Assuming that this has been done, and that all the children to be tested have been selected properly, we may say that fifty children for each age are entirely adequate for securing reliable norms. With one age-group of tests for each year from one to fifteen years it would require only 750 children. In putting the figure as low as this it is necessary to emphasize that the possibility of doing so depends on the degree of care exercised in selecting the children, and, of course, on keeping other conditions uniform. An excellent plan to follow is suggested by Pintner.¹ This

1. Pintner, R., and Patterson, D. G. *A Scale of Performance Tests*. D. Appleton and Company, 1917, p. 76.

is to compute the averages at definite intervals as one proceeds with the testing, and stop when the average ceases to be effected materially by the addition of more cases.

The selection of the children of each age to be tested involves the question as to how near the exact ages they must be at the time of the testing. Some have followed the plan of selecting only those children who are within two months of their birthdays at the time of the testing. This has certain obvious theoretical advantages, but is often impossible in practice, because of the very large number of children required from which to select those that will meet this and the various other requirements just discussed. To satisfy the requirements of securing a reliable average score for each age, children of all intermediate ages may be taken and then each child may be classified under the age that corresponds with his nearest birthday, calling all children six years old, for example, whose ages are between five years six months and six years five months.

CHAPTER III

THE CONDUCT OF AN EXAMINATION

The Immediate Object. The immediate object in an examination is to get the best response in each test that the subject is capable of giving, under the exact conditions described in the test. Only the best responses possible can give us a definite idea of the subject's ability. If it is less than this, we have no means of knowing just how much less it is. Removing all obstacles to such a response is also the only means of securing the necessary degree of uniformity of the conditions under which the tests are made for different subjects. It is much easier to secure maximum effort from each subject than it is to secure any definite degree less than this and know that it is the same for all. What we call maximum effort, however, is determined by many factors, both in the external circumstances of the test, and in the subject's mental make-up of the moment. It is difficult to judge the influence of these factors, and often their presence even escapes the examiner's observation. External circumstances can usually be more or less completely controlled, but the subject's attitude, and mental content can be regulated to a much less extent, largely because they are unknown in the first place. The guiding rule must therefore be to remove every possible hindrance to the subject's best performance. Test results that do not represent the subject's true abilities are due much more to a failure in securing his best efforts than to any inadequacy of the tests themselves.

The Importance of Following Directions Literally. The extensive and detailed directions given here and with each individual test in the next chapter aim to

secure the necessary uniformity of conditions under which different subjects respond to the same tests. The general directions concerned with conditions affecting many or all the tests will be discussed now. It is essential that these directions, both general and the special directions for each test, be followed literally at all times. By far the majority of failures and mistakes of the relatively untrained examiner are due to his failure to follow directions, which in themselves present no inherent difficulty, and relatively few are due to his lack of psychological knowledge and scientific training. The difference between the well trained psychologist as examiner and the school teacher without psychological training lies not so much in the application of psychological knowledge as it does in the difference in the appreciation of the necessity of following rules. The psychologist appreciates this necessity partly because he understands them, and partly because he has been trained for years to follow rules. The untrained cannot do so either from knowledge or from habit, and inasmuch as the mastery of the variety of details in the directions requires a great deal of time and patient work, he invariably follows the line of least resistance by neglecting to adhere to them completely. The first prerequisite for the examiner, whether he is psychologist or not, is a full understanding that the directions laid down must not be varied in the slightest detail. By this it is not meant that every slight variation in the procedure in giving a test would always invalidate the result; doubtless there are instances in which some change in the procedure would more nearly give uniformity of conditions for all subjects, or would at least do equally well. But no one, no matter how well versed in psychology or experienced in giving mental tests, can know off-hand what the effect of any change will be. Moreover, the tests are all standardized for the conditions laid down. It is known what they will do if the directions as given are followed liter-

ally. It is not known what they will do when changes are introduced.

One of the surest signs of lack of scientific training on the part of an examiner, and also the most fatal to mental tests, is that critical attitude born of a few chance observations, which leads him to change the tests or their directions in some respect with the view of improving them.

Experience with mental tests has proven repeatedly that there is but one sure way of knowing what the effect of a certain condition under which a test is given will be. This is the empirical way of trying it out and observing. It is only those who have not had this experience who do not realize the gravity of not adhering strictly to formulae.

No attempt should be made, even by the most experienced, to give the tests with only an abbreviated form of the directions before him, such as a list of the tests with a few catch phrases of the procedure only. The full text as given in the next chapter should be used at all times. No one is capable of keeping all the necessary details memorized, no matter how many cases he has examined. An abbreviated text, erroneously supposed to be more convenient, invariably results in gradual, unconscious modifications of the procedure until quite unpermissible changes are introduced.

Numerous instances have been revealed in the use of the present tests in which very slight variations in the procedure in giving a test produced entirely unforeseen influences on the results. Thus, the seven-year-old subject's reaction to a picture may be that of a three-year-old as the result of the form of the question asked. In general, the former can describe a picture, while the latter can only enumerate a few of its individual objects. If the seven-year-old is asked "What do you see in that picture?" he is as likely to enumerate as to describe. If he is asked "What is that picture about?" he is much

more likely to describe. Since the object is to find out whether the three-year-old can enumerate, and whether the seven-year-old can describe, it is important to adhere to the exact form of the question that is most favorable to an expression of the ability to be tested in each case. Immediate memory for a series of numerals read to the subject is very much dependent on the rate and rhythm at which they are read. The most favorable rhythm is probably very largely dependent on each individual subject, and the elimination of all rhythm is therefore to the best interests of uniformity. But the exact rate at which the series is read is also very important. A second or two more or less for reading a series of five numerals often decides whether the response shall be a success or a failure. It is therefore not permissible to vary the rate from one subject to another by as much as two seconds. The ability to count the number of taps in an irregular series is entirely dependent on the rate, and the nature of this irregularity. It is therefore important not only that the series be given in the rhythm indicated, but also that it be at the exact rate required. The applicability of these few instances can be readily verified. The observant examiner using the tests soon discovers others for himself in abundance.

An examiner is not skilled in the use of the tests or qualified to do serious work with them until he has made most of the details of the various directions so much his own that he will follow them automatically. His attention is needed at all times for other matters sufficient in number and variety to engage it. If it must be used largely in managing the really mechanical aspects of testing, reliability of the results must necessarily be the sacrifice.

Control of the Subject's Interest, Attention, and Attitude. In order that the subject's response may be the best he is capable of giving he must be interested in the task in hand and apply himself with his best effort,

unhampered by any external or internal distractions. External sources of distraction are relatively easily guarded against and sufficiently appreciated by most examiners. It should be unnecessary to urge the need of quiet and seclusion for the examining room. Sudden noises just at the wrong moment are sure to make the results of some tests entirely worthless, and partly invalidate the results of others. Most of the tests cannot be immediately repeated in exactly the same form and remain exactly the same tests. The value of a secluded room is often overlooked. The subject should be made to feel as far as possible that the examination is entirely private, and entirely unknown to his playmates or other associates. In a school, reformatory, or other institution where a long series of examinations is made, it is not always possible to keep children from jeering, taunting, or otherwise annoying those who have been called in to have the "brain test," and when a subject is conscious during the examination of such a reception he is not likely to make his best record. Such a situation, although not usual, should be guarded against. Class rooms, hallways, rooms that are likely to be entered by others during an examination should not be used.

The examination room should also be free from visual distractions, the more barren of furnishings, pictures, and so on, the better. A good light, a table and two chairs are all that is necessary. The subject should be placed at the end of the table, with the examiner at the side, having the subject on his left. The record blanks, and testing materials may then be placed on the table furthest away from the subject. The examiner should record all responses in as incidental and inconspicuous a way as possible. Older subjects are sometimes considerably distracted by the examiner's carefully recording of every response made. If the recording blank is next to the subject, his attention is sure to be arrested repeatedly by this process. The testing material should

all be placed face down, and arranged in the order in which it will be used in the examination. Each part should be replaced in the same manner at once after using it. This will eliminate unnecessary movements and delays on the part of the examiner, and also call the attention and arouse the interest of the subject to each part of the material in its proper turn. It helps to sustain the novelty of the procedure, and checks fatigue and ennui.

The time for the examinations should be considered. The part of the day in which they are made is in itself not particularly important, except for subjects under three years of age. More or less marked differences in the mental abilities of adults at different parts of the day have been found, but these are on the whole probably smaller than are at present measured by any system of general intelligence tests. Besides, aside from the immediate effects of meals, or other regularly occurring deterrent, these daily variations vary with the individual, the best and poorest parts of the day being not the same for all. The individual characteristics of the subject in regard to this, not being known to the examiner, cannot be taken into account in the examination. Any part of the morning or afternoon of the working day is satisfactory. Within these limits, however, certain hours should be avoided. The hours of the subject's regular occupation are most favorable, as, for instance, the regular school hours of school children. This assumes that the tasks in the examination will be more interesting to the subject than his regular occupation. To take him away from an unusually interesting occupation to be put through a series of tests is likely to call forth something less than maximum effort in the tests. Hours before or after school, the noon hour and recesses particularly, should not be used to examine school children. A child is not likely to enthuse over a mental test if his mind in

the meantime is on the interesting games his school-mates are playing just outside.

All external sources of distraction being removed, the control of the general attitude of the subject is next. The chief obstacles to a maximum effort that may be described under the term of general attitude are timidity, obstinacy, indifference, and over-confidence. The elimination of these factors calls for tact on the part of the examiner. It is difficult to lay down rules for their control. The natural fear and timidity of young subjects can practically always be entirely overcome in twenty minutes or so at the most, if the case is properly handled. If immediate methods fail to put the child at ease, he may be left in the examining room, with some suitable playthings while another subject or two are examined. Calling in the child's parents to quiet and reassure it usually fails in its object.

Indifference to the tests is rarely found. The tasks set are, on the whole, usually in themselves interesting. Exceptions occur with older subjects, but if it is mere indifference, a sufficient motive can nearly always be readily given the subject that will change this attitude.

Over-confidence is readily dispelled by giving the subject a test or two in which he will fail, choosing the test so that the failure must be obvious at once to the subject himself.

The only attitude that cannot always be overcome with the best of patience and tact is obstinacy, when no cause for it can be discovered. The unconditional and unfounded "I won't," be it expressed in words or action, is sometimes final. If the examiner fails in such a case the subject should be dismissed, and called in again a week or more later. In this second trial it is usually best to attempt to proceed at once with the tests, without any preliminaries, whatsoever, and, above all without any reference to the previous visit and experience. If possible, the case should be tried by another examiner

the second time. The cases in which this kind of seriously unfavorable attitude has to be corrected are exceptional, but occur frequently enough to require means of control to be at hand when they do occur. They are most likely to occur in groups of older children, all of whom are being examined by one or two examiners, so that the examinations extend over a considerable period. In such circumstances extra precautions are necessary to prevent a general spirit of antagonism against the tests arising among those who are yet to be called in.

The examination should not as a rule be begun immediately after the arrival of the subject. The first several minutes are best spent in getting him adjusted, so to speak, to the situation. The examiner tells him to have a chair at the table, asks his name, age, where his home is, and general questions on subjects most likely to interest him, such as his school work, teachers, occupations, and so on. This will serve the additional purpose of acquainting the examiner at once with about the level of intelligence he may expect to find, so that he will know where in the scale of tests he should begin.

If he finds the subject at ease the tests proper may begin by giving the subject a special motive for putting forth his best effort in the tests. The control of this special motive varies widely with subjects of different ages and mental levels. The procedure can best be indicated by considering roughly three age periods, or levels of mental development. The first is from the mental age of zero to two years; the second from three to ten years; and the third from ten years to maturity.

For the first age-period a conscious motive hardly comes into question. The first desideratum is comfort, and wide-awakeness. A subject less than two years should be held by the mother or nurse. Such tests as involve only reflex reaction call for no further preliminaries, but it is best to begin trying to attract the attention and interest of the child with appropriate toys.

A variety of these, other than those directly required in the tests, should be on hand. In general, the younger the subject, the more difficult is the task of control for examining purposes. The examiner must be more tactful and experienced in the handling of young children than is necessary for older children and he should be thoroughly familiar with the psychology of infancy and early childhood. It is usually necessary to do a great many things not outlined in the tests, in order to attract the child's attention and arouse his efforts, and the procedure in the tests themselves must often be varied somewhat in order to fit them into the circumstances that arise. Not infrequently no response to a test can be obtained because the child is obviously not in a mood to make any response at all. The last resort is then questioning the mother or nurse as to whether or not the child ever does the things called for in the test, and have her describe them. In this questioning caution and experience are also required. Leading questions are of no value. In the eyes of a parent any effort merely to walk, for example, is likely to mean ability to walk. Questions requiring only a yes or no answer should be avoided where possible. The responses obtained from the child are on the whole less clear-cut and more difficult of exact scoring than is the case with older children. Interpretation on the part of the examiner must play a large role. The examiner untrained in psychology, and unfamiliar with the traits of young children, and inexperienced in the use of the tests should not attempt to work in this field and place the same reliance in the results as he might in the results with older children. This does not mean that the tests are necessarily less accurate, but that they are more difficult to employ.

Subjects from three to ten years of age or of equivalent mental levels, are the easiest to manage. The tasks the tests require them to do are for the most part in themselves interesting and will of themselves call forth

attention and effort. This tendency, however, should be re-enforced by special methods if there is any occasion at all for doing so. After the preliminary questions as to name, age, and so on, have been asked, begin at once with the first test, chosen from an age-group about two years below the mental age you have roughly judged he may have. If the first several tests are found much too easy or much too difficult for the subject, skip at once to a higher or lower point in the scale. The subject's general attitude is likely to be spoiled at the start if the first tests he gets are so easy that they make him feel that you have a very poor opinion of his abilities. If the first tests are quite beyond his capacities he is likely to be discouraged and feel that he will not be able to do as much as is expected of him. Make sure that you have the subject's attention for each test. Watch his movements, eyes and expression constantly, but without staring or making him self-conscious. The habit of observing carefully in indirect vision in an apparently incidental and inuifferent way should be cultivated. Repeat the initial "Listen," "Look," "See this," and so on, in the directions of the test until the subject's attention is aroused. In many instances it is not permissible to repeat a test because he did not respond the first time on account of inattention. At the same time, make sure that the subject understands directions given him, knows just what he is to do, in all tests in which this comprehension of the directions is not itself a part of the test. The aim of each test is to find out if the subject is capable of doing the task set under the exact conditions described, and when he is making his best effort, unhampered by any external or internal distraction. Some of the tests aim directly at the determination of the subject's ability to comprehend directions. In the tests in which this is not the aim this factor should be eliminated by making sure that he understands. This must be done by repeating the instructions or by varying

them in the way that the occasion demands. So long as the task to be done remains the same, this procedure does not effect the results. It is a matter, however, about which the greatest caution needs to be exercised, lest by these variations in the procedure the nature of the test is thereby changed. As much as possible these variations from the usual procedure are given in the directions for the tests, but they can meet only those circumstances that arise more frequently, and occasionally the examiner must in his own way adjust the procedure to some unusual circumstance that has arisen.

A variable and fleeting attention is one of the central mental traits of all young children, this being one of the last functions to develop fully. Therefore, unless unusual precautions are taken to control this factor in the tests the response in each test would likely be largely a result of the degree of attention given as much or more than of the other functions involved. The final scoring for a subject would then indicate his ability to attend rather than the level of his general mental development. The tests themselves are so constructed as to guard against this ever present danger, by usually allowing several trials and scoring a pass if the subject succeeds in only one, or two, or three of them. A few failures do not count if in one or more successes he proves himself capable of doing the task set.

Assuming that the subject's best attention is secured in each test, the examiner should encourage and praise copiously. Praise is by far the most effective single stimulus to maximum effort that is available for this age. It cannot be readily overdone with young children, and is almost equally effective with older children, if given in the proper form. For children below eight or nine years repeat "That is very good," "That is fine," "That's just grand," and similar remarks, after most of the responses made by the subject. If the subject himself remarks that he has done poorly or has failed, agree with him,

but explain that he has still done very well for so difficult a task. This will all be entirely true if the examiner himself has succeeded in making the subject do the best of which he was capable, inasmuch as effort and not accomplishment alone deserves praise.

Subjects over ten, and especially those approaching mental maturity often take a different attitude from that of younger children towards mental examinations. A somewhat different set of emotions have to be dealt with, and, unless controlled, will stand in the way of the subject's getting as good a score as he is capable of attaining. As a rule, they have a more or less definite knowledge of the general purpose of the examination. They often understand that the aim is to determine their grade of intelligence. To younger subjects the whole procedure usually appeals as some game, and it is in this general spirit that the examiner carries out these tests. The nature of the tests enforces this attitude. The tests for the older subjects are different, and the subjects, especially because of their understanding of the aim, can no longer be approached in the game spirit. According to just how the subject regards the tests, his first reaction on being called into the examining room may be either resentment, embarrassment, or mere excitement. If he feels that he is being examined to find out whether he is mentally normal or not he is sure to resent the procedure, and about in proportion to his intelligence, or be embarrassed instead. Reformatory and court cases react in this manner oftener than others. The great majority of the older school children, although they understand the aim equally well, are concerned over the tests in about the same way as they would be over a regular school examination. This is the most favorable attitude for the tests, and it should be the aim of the examiner to establish it by a special procedure whenever there is evidence that the subject does not regard the examination more or less in this way. Undue excitement through

fear of not making a good record, or from some other cause, should likewise receive attention.

As in the case of the control of timidity, obstinacy, and so on, with younger subjects, so here it is difficult to lay down rules. It is always useless to argue the aim of the tests with the subject if he is inclined to doubt your general statement. On the whole, the less said before proceeding with the actual tests the better. Make no explanations not called for by the remarks or behavior of the subject. After the preliminary questions, proceed at once with the tests. As you continue, do not fail to acknowledge a good score with some favorable comment. Praise should not be as lavish as with younger subjects, but should not be omitted where at all in place, and should be put in a form suitable to the intelligence of the subject. Consciousness of a failure or poor score should be as scrupulously combated as with the younger subjects. No one is so intelligent or capable but what consciousness of success and another's acknowledgment of it is a spur to still better effort. With the older subject, however, this is no longer the chief motive through which his effort can be controlled. With him the strongest stimulus is his knowledge that his ability is being measured, and the natural pride that every human being takes in his own mental powers. This the examiner should keep in mind. It is not objectionable to let the subject see in some of the tests what mistakes he is making as he completes each part. Such tests are especially drawing the four lines of the circles from memory, drawing the squares upside-down, drawing the triangles on the squares, and a few others. As long as he understands that an errorless score is not expected a definite knowledge of mistakes made helps to keep up the effort, especially if he happens to make some unusually good scores. Throughout the procedure the examiner should be careful to maintain a spirit of absolute fairness to the subject. Credit should be given rather than withheld

wherever there is a reasonable doubt. Directions should be explained until there is no question about the subject understanding exactly what his task is.

The time and error scores are not of equal value as an indication of mental ability in all the tests. This may be seen from the different formulae used in combining the time and error scores, which by no means attribute equal values to the two scores in all cases. While on the whole it does not make a serious difference whether the subject works fast at the expense of accuracy, or works carefully and takes more time, there are limits outside of which this no longer holds true. The average subject can do some of the tests without any error if he takes enough time, but this combined time and error score would be poorer than if he divided his effort more equally towards getting a good score in both time and error. Likewise, the aim of the subject should not be too exclusively directed to getting a good time score, inasmuch as his errors will then increase out of proportion to the time that he saves. The examiner should keep in mind about what the average time and error scores are, and the limits of their variation above and below this average. If the subject seems to be going to an extreme in any test he should be cautioned to "take his time," or "be careful about mistakes," or to "see how fast he can do it." Where general tendencies of this sort have been found special directions on it are given with the directions for the tests. But occasionally still further precautions are necessary with some subjects. The tendency to do a test fast at the expense of accuracy occurs more frequently with different subjects than the tendency to work unduly slowly but accurately.

The necessity of the examiner adjusting himself in his own general attitude and conduct to the mental level of the subject he is examining needs no special explanation. He should be equally at ease with the "baby talk" in the examination of infants, the childish mannerisms

of the young child, and the dignity of mental maturity. To fail seriously in this inevitably leads to disastrous results. One can readily imagine the reaction of a subject of ten or more if he were approached as though he were a child of two or three. But all possibility of getting a maximum effort from a subject is easily removed by a lesser degree of failure on the part of the examiner to approach the subject in the right way. While few examiners err in this direction, many fail to get down to the level of the younger subject, and among these the best trained psychologists are sometimes included.

A few further considerations concerned with securing the subject's maximum effort need to be taken into account. Their importance deserves a separate discussion. These are: (1) the presence of a third person in the examining room; (2) recording responses and taking notes; (3) fatiguing the subject; (4) order of giving the tests and range of tests to be used.

The Presence of a Third Person in the Examining Room. The effect that the presence of others may have on the subject under examination depends in the first place, of course, on the particular person, personal traits of the individual subject. But it depends also, in general, on his age and mental level. The former must be left to the observation and judgment of the examiner with each subject. With regard to the latter certain general facts may be noted. Subjects less than two years are rarely affected by other persons being present and for subjects a year or less the presence of the mother or nurse is required. On the whole, older subjects are less affected by the presence of strangers than by that of parents, other relatives, their teachers, or other close associates. The presence of a stranger, or even a number of them, is often not particularly objectionable in the case of subjects less than ten years. For subjects beyond this age or mental level, the presence of any third person should be absolutely forbidden. Likewise, for all subjects above the

age of two years the presence of a parent, other relative, or close associate of the subject should not be permitted under any circumstances. Whenever a third person is allowed to be present in any case he should be seated outside the direct line of vision of the subject, should make absolutely no remarks, remain quiet and apparently as indifferent and unobservant of the subject and the examination as possible. It is always difficult and sometimes impossible to instruct a parent in such a way that he will adhere to this rule. But even when he does adhere to it the subject will not fail to be distracted in various ways by his presence. The only possible satisfactory procedure is not to allow his presence. Subjects above ten years almost invariably react unfavorably to the presence of any third person, because of embarrassment caused perhaps chiefly by his having some knowledge of the purpose of the examination. It is much easier to make a cast-iron rule and adhere to it literally at all times than to allow exceptions where permissible and adhere to the rule where necessary.

Recording Responses and Taking Notes. All responses should be recorded in the briefest possible manner, on a convenient blank such as is furnished with the testing materials. Every effort has been made to make this blank as compact and convenient as possible. The responses to nearly all of the lower age tests are scored directly as passes or failures, which may be indicated on the blank with plus and minus signs, respectively. Where the pass or failure is determined by combining the time and error scores, as is the case with all the higher age tests, too much time should not be taken while the subject is left unoccupied to make the computations. The time and number of errors alone should be recorded in the marginal spaces provided for this, and the scores computed at any convenient moment during the examination while the subject is at work on another test, or after the examination is completed. A card is furnished with the testing

materials that gives each test having a time and error score, and which occurs in two or more age-groups, together with the scoring formula and scores required for passing at each age. With the aid of this card each such test can be scored rapidly in all its age-groups from the computed score combining time and errors. It is conducive to both convenience and accuracy in counting up the results to place all the scorings for the a's, b's, c's, and so on, immediately to the right of these letters, and to place all the scorings for the test numbers, 1, 2, 3, and so on, immediately under the numbers. The number of tests passed in an age-group can then be easily counted by noting the number of plus signs in the interlinear spaces, without confusing them with the other plus and minus signs. This number of tests passed in each age-group may then be placed in the left margin of the blank, which will bring them all together in a vertical column for adding.

Time should not be taken during the examination to take additional notes on chance observations not directly concerned with the responses of the subject and their scoring. Only when the response is of such a nature that the manner of its scoring is for the time being in doubt should the response itself be recorded or special note made on it, so that it may be considered at leisure after the examination. For an experienced examiner this will hardly ever be necessary. Observations of special interest can be recorded, largely, immediately after the examination. They often are of considerable value in giving additional information concerning special traits of the subject. But such observations, no matter how striking, should never be used in determining the subject's final standing, or level of mental development. Only the number of tests passed should count in this. One of the main features of mental examination by a system of mental tests is its objective character, the independence of the final result from the judgment of the examiner. If

the determination of the subject's mental capacity is to be made after all partly through the use the examiner makes of side observations while giving the tests the value of the test result itself is mostly destroyed.

The elimination of everything but the essentials in the recording of responses during the examination itself is for a double purpose. First, it leaves the examiner freer to attend more carefully to the other matters in the conduct of the examination. Secondly, it removes a considerable source of distraction to the subject. It is a distraction to have the subject wait between tests while the examiner takes notes. To the older subjects the careful taking down of his responses or other observations that he knows are about himself is likely in itself to be disquieting. For the latter reason it is also entirely objectionable to have a stenographer present to take down responses in full. The stenographer can add but little to the value of the record as a record, of the experienced examiner, and his presence and note-taking are certain to detract much from the value of the subject's responses as expressions of his abilities.

Fatiguing the Subject. Only general statements can be made in regard to the amount of time that may be spent on an examination in a single sitting without unduly fatiguing the subject. No definite observations have yet been made directly on this question. On the whole nearly an hour is necessary to examine a subject with a mental age between six and ten years. The lower the mental age the less time it takes, in general, to determine it, both because a smaller number of age-groups of tests need to be used and because the tests themselves in the lower age-groups take less time to give. The higher age tests are probably on the whole more fatiguing than the others. The subject works on these tests more with an artificial interest, instead of with the natural spontaneous interest of the younger subject that is given tasks that are in themselves more interesting. The ap-

plication is closer, and the effort more voluntary and forced. But whether these several things are sufficient to cause a degree of fatigue that would seriously affect the scores is questionable. General observations on the subject's reactions during the examination do not often indicate any effect of fatigue. It is safe to make the assumption that the great majority of subjects, of whatever age, will not be unduly fatigued in the time necessary to complete the examination. But there is no objection to giving two sittings to a subject. If this is done the subject should be dismissed at the end of the first sitting with the statement that this is enough for today, that you do not want to get him too tired, and that he may come in again some other time to do the remainder. In schools and institutions this procedure involves hardly any inconvenience, none on the part of the examiner, and causes but little loss of time. The inconvenience to the subject of coming a second time is the chief objection. On this question of one or two sittings, the examiner should follow the rule of completing an examination in one sitting unless special reasons appear by the time the first four tests of each age-group have been given that favor a second sitting.

Order of Giving Tests and Range of Tests to be Used.

The tests should be given in the order as found in the text, unless special reasons appear in any individual case to take a test or two out of its order. It is best, however, to use only the first four tests in each age-group and complete the range of tests required first in this way. When this is done the second four tests in each age-group should be given in the same way. In this way the tests can be carried further without bunching so many at the end that are too difficult for the subject, and it avoids also giving so many at the beginning that are too easy for him, and thus helps to maintain the proper attitude towards the tests on the part of the subject. The examination should begin with an age-group about two

years below the mental age that is expected, and continue in both directions until all the tests are passed in the lowest age-group used, and none are passed in the highest age-group used. An experienced examiner may allow exceptions to this rule, when he is certain that no higher age tests would be passed and that all lower age tests would be passed should they be given.

Using the Scale of Tests in Abbreviated Form. The present scale of tests may be used in an abbreviated form, by omitting some of the tests from each age-group. The reliability of the result is thereby reduced, but not in proportion to the number of tests omitted. When time does not permit using all the tests, or when only an approximately correct mental age is required, the first two, three, or four tests of each age-group should be used. If there is motor in-coordination, or visual or auditory defect, or speech disturbance that would seriously interfere with the performance of some of the tests, the tests involved may be omitted, even though it results in an unequal number of tests remaining in the different age-groups. Usually enough tests will remain to give a much more reliable indication of the general level of mental development than could be secured without the tests. Again, some children are especially hesitant in giving verbal responses. This is true of rural children as a class. When this tendency is marked the following tests only may be used. III, 2, 3, 7, 8; IV, 3, 4, 5, 6; V, 1, 2, 7, 8; VI, 2, 6, 7, 8; VII, 2, 3, 7, 8; VIII, 1, 3, 4, 8; IX, 1, 4, 7, 8; X, 1, 2, 4, 7; XI, 1, 4, 5, 8; XII, 1, 2, 6, 8; XIII-XV, 3, 4, 5, 7. These four tests from each age-group are not in all instances those requiring the least verbal response, as another matter had to be taken into consideration to secure correct results. Many of the non-verbal tests have also the greatest discriminative capacity, and if only the latter were used the mental age as determined by these tests alone would tend to be too low.

Rules for Determining Mental Age. The number of months that each passed test counts for in determining the mental age depends on the number of tests used in each age-group and the age intervals between age-groups. When all tests in each age-group have been used it is as follows:

| | | | | | | | |
|-------------------|--------|--------|---------|---------|-----|-----|----------|
| Age-groups | 3 Mos. | 6 Mos. | 12 Mos. | 18 Mos. | II | III | IV, etc. |
| Months per test.. | .6 | .6 | 1.2 | 1.2 | 1.2 | 1.5 | 1.5 |

There are three conditions calling for slightly different procedures in determining the mental age. For mental ages of about four to eleven only the second comes into consideration.

(1) **When there are some unpassed tests below age-group III.** Example:

| | | | | | | | |
|--------------------|--------|--------|---------|---------|----|-----|----|
| Age-groups | 3 Mos. | 6 Mos. | 12 Mos. | 18 Mos. | II | III | IV |
| Number passed..... | 5 | 5 | 5 | 4 | 3 | 1 | 0 |

The mental age in this is $12 + (4 \times 1.2) + (3 \times 1.2) + (1 \times 1.5) = 21.9$ months.

(2) **When there are no unpassed tests below age-group III and not more than two passed tests in age-group XV.** Give the subject the mental age corresponding to the highest age-group in which he passes all the tests and below which he passes all. Then add one year for every eight tests passed in all age-groups above this point. Example:

| | | | | | | |
|--------------------|-----|----|---|----|-----|------|
| Age-groups | III | IV | V | VI | VII | VIII |
| Number passed..... | 8 | 8 | 6 | 3 | 2 | 0 |

The mental age in this case is $4 + \frac{(6+3+2)}{8} = 5\frac{3}{8}$ years.

(3) **When three or more tests are passed in age-group XV.** Use the scores made in the last ten tests only. These tests are indicated by the numbers 1 to 10 in parenthesis. They are, (1) "Giving the associated

numbers for the dissected parts of a simple form"; (2) "Crossing out q, r, s, t in a pied text"; and the eight tests in age-group XIII-XV. The average scores, or norms, for these ten tests are as follows:

| | | | | | | |
|--------------------|-----|-----|-----|-----|-----|-----|
| Age | 10 | 11 | 12 | 13 | 14 | 15 |
| Average score..... | 210 | 175 | 150 | 130 | 113 | 100 |
| Difference | | 35 | 25 | 20 | 17 | 13 |

The average of the ten scores on these ten tests are 210 for normal ten-year-olds, 175 for eleven-year-olds, and so on. To find the mental age of any subject examined, compute his average score for the ten tests.

Example:

Average score on the ten tests is 145. The mental age is then $12 + \frac{150-145}{150-130} = 12 \frac{5}{20}$ years.

This procedure makes it possible to score mental ages correctly up to and including the maximum mental age of fifteen. This cannot be done with the Binet-Simon method of scoring the mental age when the subject passes several of the tests in the highest age-group of the scale. Such a subject would also pass a few still more difficult tests than those of the highest age-group, were such tests given. The mental age as determined by this old method would consequently be too low. This is likely to be the case for all true mental ages much above eleven. In some rare instances a subject who passes three or more tests in age-group XV will make so very low a score in one or two of the other tests that his average for the ten tests gives him no higher, or even a slightly lower mental age than he gets by the Binet-Simon method of scoring. This becomes less and less possible, of course, the higher the true mental age. In such a case the method of scoring should be used that gives the subject the higher mental age.

Determining the Grade of Intelligence. Mental ages do not indicate the grade of intelligence, except for adults. To find the latter, divide the mental age by the age using the fractions of a year in both the mental age and age. The resulting figure gives what has been termed the "Intelligence quotient." These intelligence quotients for different ages and mental ages are given in the Appendix below. Development of intelligence stops approximately at the age of fifteen, so far as it has been determined by these tests, and the scale registers mental ages up to this point, which is the highest possible mental age, since mental age means the mental level of the average child of corresponding chronological age. The mental age should, therefore, never be divided by more than fifteen, no matter how much older the subject may be. But some subjects are more intelligent than the average adult. These cannot be given a mental age, but their grade of intelligence is still indicated by the score they get on the last ten tests in the scale. This score will then, of course, be better than 100, that is, below 100, as it represents the combined time and error scores. In order to make each test count for as much as any other in this group of ten, the scoring formulae have been so adjusted that the average score for fifteen-year-olds is just 100 for each of the ten tests. Suppose now that a subject aged thirteen gets an average score of 90 on these ten tests. This may then be taken to represent his grade of intelligence directly when compared with another of the same age. It represents a given level of mental development, in the same way as does the mental age. If his grade of intelligence is to be compared with that of another of a different age, it should be expressed by $\frac{1}{90} \div \frac{1}{130} = 1.44$. This 1.44 has roughly the same value as the intelligence quotient in other instances.

CHAPTER IV

DIRECTIONS FOR GIVING THE TESTS

The following description of the tests gives them by name and number, arranged in order under each age-group. The age-groups are indicated by Roman numerals, except those below two years. The number of each test in an age-group is given in Arabic, and the separate trials or parts of a test are shown by letters. Thus, IX, 7, a is the first trial in the seventh test of age-group nine. To facilitate its use, the text is freed from all matter not essential to giving the tests or scoring responses. Comments of secondary importance in using them, or chiefly of scientific interest, are collected in the next chapter. In the testing materials the test numbers are given on the backs of the cards used, but not on the paper blanks needed in some of the tests. For the former these test numbers identify the material required in each test, so that no further description is necessary in the text. Thus, in Test VII, 4 the directions read, "Show the pictures for this test in their order," etc., without indicating the nature of the pictures. But in the materials furnished will be found the four cards needed, labeled VII, 4a, VII, 4b, VII, 4c and VII 4d, respectively, on the back. The directions for giving a test usually identify also the paper blank that is required. The following description, however, of this paper material will be helpful to the beginner.

Test III, 8. A six-inch square of paper with two large squares on it, one inside the other, and a dot between the upper sides of the two. The child draws a line between the parallel sides of the squares, beginning at the dot.

Test IV, 5. Same as in III, 8, except that the figure is an irregular one instead of a square.

Tests VI, 7, and VIII, 7. A plain six-inch square of paper for paper folding tests. The examiner must make sure that he does the folding exactly as called for in the directions.

Tests VIII, 4, and XIII-XV, 6. An eight by ten-inch sheet of paper with six one-inch squares on it. Each of the six squares has a dot in its center and in the middle of each side.

Tests IX, 6, XI, 8, XII, 6, and XIII-XV, 3. An eight by ten-inch piece of paper with ten one and a half-inch circles. Each circle has a dot in its center and in the circumference at the top, bottom and right and left sides.

Tests X, 7, XI, 5, and XII, 3. A six by eight-inch sheet of paper with p i e d alphabet on it, and q r s t at the top.

Tests XI, 6, XII, 4, and XIII-XV, 1. A six by eight-inch sheet of paper with forty simple problems in adding, subtracting, multiplying and dividing, arranged in two columns.

Tests XII, 7, and XIII-XV, 4. A six by eight-inch sheet of paper with a confusing text of directions to be followed, beginning, "With your pencil make a dot"

Tests XII, 8, and XIII-XV, 5. An eight by ten-inch sheet of paper with a large square, divided into quarters by heavy lines, these quarters being divided again into quarters by lighter lines, and each resulting small square having a dot in its center and in the middle of each side.

Tests XIII-XV, 7. An eight by ten-inch sheet of paper with six two-inch squares on it. Each square has a dot in the center and four dots inside the square.

Score sheet. Five and a half by eight-inch sheets with the scoring blanks. The score sheet is made as small and condensed as possible, for convenience in scoring and to avoid the bulky accumulation of records. Tests not involving the combining of a time and error score may be scored at once on the score sheet with plus and minus signs, the plus indicating a pass and the minus a failure in the test. These signs should be placed to the right of

the letters a, b, c, etc., indicating the trials of a test, and under the Arabic numerals indicating the test 1 to 8 in each age-group. The total number of tests passed in each age-group is then placed on the short dotted line in the left margin, preceding the Roman numeral indicating the age-group. In the available marginal spaces on the right and at the bottom the tests involving the combining of a time and error score are listed again with headings, t, e, T, E, and S. Under or to the right of t and e record the time in seconds and the number of errors per trial of a test. For the T and E record the average time and total number of errors in the test, as called for in the directions for scoring the test. For the S record the combined time and error score. The test may then be scored in the different age-groups in which it occurs in the score sheet, with plus and minus signs as in the case of the other tests.

Scores required for passing. A six by eight-inch card giving the scoring formulae and scores required for passing for tests having a time and error score, and which occur in more than one age-group. This card eliminates the necessity of searching through the text for this data in scoring the test for the several age-groups in which it is used.

The materials furnished with the text does not include a series of five weights that are required in tests V, 3, and IX, 2, and are used also as blocks merely in V, 1, V, 7, and VI, 8, nor such toys and things as are needed for children with mental ages below three years. The latter may be secured in any toy shop, if these lower age tests are to be used. The weights should weigh 6, 12, 18, 24, and 30 grams, but a series weighing 3, 6, 9, 12, and 15 grams, obtainable from C. H. Stoelting & Co., Chicago, may be substituted, as they give the same results. The series is easily made out of cardboard pill boxes, filled with pieces of metal or shot, wrapped in cotton with diluted liquid glue to prevent any rattling. The rectan-

gular boxes with square ends, and about $1 \times 1 \times 1\frac{1}{2}$ inches are best. For convenience of identification they may be marked on the bottoms with the letters B, I, N, E, T in the order of their weights. If the gram weights are not on hand the following coins may be used in weighing the boxes to get them of correct weights.

For 6 grams use 2 pennies

For 12 grams use 1 dime and 3 pennies

For 18 grams use 1 dime and 5 pennies

For 24 grams use 1 dime and 7 pennies

For 30 grams use 2 dimes and 8 pennies

A stop-watch is not absolutely necessary, but adds greatly to the convenience of testing, and eliminates any chance of error that might be made in using an ordinary watch. One who expects to use the tests frequently should have a stop-watch. In all time scores the time is expressed in seconds.

In an examination the cards and paper blanks of the same size should be put together, arranged in the order of the test numbers on them, and placed face down on the table as far away from the subject as possible.

AGE THREE MONTHS

1. CARRYING HAND OR OBJECT TO MOUTH a. Place a small block or other object in the child's right hand, and note if it is carried to the mouth. Repeat for the left hand.

b. If the object is not carried to the mouth in these trials observe the movements of the child throughout the examination, and note if the hand is ever carried to the mouth at will.

Scoring. Passed if in either "a" or "b" it is determined that the child has sufficient motor co-ordination to carry the hand to the mouth more or less at will, and not merely through random, chance movements. Sucking of finger or object held in hand is not sufficient evidence.

2. REACTION TO SUDDEN SOUNDS. a. Snap a telegraphic snapper within two inches of the ear. Give not more than two trials for each ear, and at intervals of a minute or more. If a satisfactory reaction is not obtained, proceed with the next test or two and then try the following:

b. Clap your hands loudly near the child's head, somewhat back of the ears, so the child will not see the moving hands. Give one trial for each ear, at an interval of a minute or more.

Scoring. Passed if the child reacts readily with a marked "start" or wink.

3. BINOCULAR COORDINATION. a. With the child facing away from the window or other source of light, move some bright object, an electric lamp, or other shining object that is found to attract the child's gaze readily, in front of his face, first from right to left and back, then down directly in front of the face and up again, then diagonally. Keep the object about two and a half feet from the eyes. Move to extreme positions in all cases.

b. If the child's eyes do not follow the moving object readily, or very far in any direction, repeat the test in a darkened room, with a lighted candle. Avoid fatiguing by too many trials in immediate succession.

Scoring. Passed if no marked inco-ordination occurs, even when the eyes are turned to quite extreme positions.

4. TURNING EYES TO OBJECT IN MARGINAL FIELD OF VISION. a. With the child facing away from the window or other source of light, move some bright object, an electric lamp or other shining object that is found to attract the child's gaze readily, slowly into the child's field of vision from the back and side, and keep it in the marginal field. Try several times, alternating sides.

b. If a satisfactory reaction is not obtained in "a", repeat the test in a darkened room, with a lighted candle. Avoid fatigue by too many trials in immediate succession.

Scoring. Passed if the child turns the head and eyes towards the object, or better, if the eyes are turned much without turning the head.

5. WINKING AT AN OBJECT THREATENING THE EYES. Make a sudden pass towards the child's eyes with the flat side of a book, a hat, or other large object. Repeat several times.

Scoring. Passed if the child winks to the threat.

AGE SIX MONTHS

1. BALANCING HEAD AND SITTING. a. *Balancing head.* Hold the child so that the head may drop forward, to right, to left, and backward. Note also, when the child is held in the vertical position, whether he keeps the head balanced.

b. *Sitting.* Note if the child sits up indefinitely when supported with a pillow in the back. Also, place the child on a chair or stool without any support in the back.

Scoring. Passed if in "a" the child keeps the head balanced, that is, in the axis of the body, most of the time, and if in "b" he sits up indefinitely when supported in the back, or five to ten seconds without support.

2. TURNING HEAD TOWARD SOURCE OF A SOUND. a. With a telegraphic snapper in each hand, place your hands in symmetrical positions opposite the child's ears, about two feet from the head. Snap one of the snappers several times in quick succession. Give several trials, alternately for the right and left ears.

b. If the response is unsatisfactory, repeat with a small hand bell and change to other hand, or have the mother or nurse, standing back and to one side of the child, speak to it.

Scoring. Passed if the child turns head towards the sound more or less readily.

3. OPPOSING THUMB IN GRASPING. a. place an inch cube in the child's right palm. Repeat for the left.

b. Repeat with pencil pressed lengthwise across the palm. In all trials lift the thumb to note the degree of opposition.

Scoring. Passed if the object in the palm is clasped with the thumb in most cases as well as with the fingers, or if the thumb presses firmly against the forefinger while holding the object.

4. PROLONGED HOLDING OF OBJECT PLACED IN HAND. Place an inch cube, ball, bell, rattle, or other small object in child's right hand. Repeat for the left.

Scoring. Passed if the object is held considerably longer than in the usual reflex clasp.

5. REACHING FOR SEEN OBJECTS. a. Dangle a bright object, small hand bell or colored ball, before the child's eyes within his reach. Give several trials.

b. If there is no reaction at all, ask the mother or nurse whether the child frequently and successfully reaches for objects, and let her describe several instances.

Scoring. Passed if the child reaches readily and successfully for the object in the test, or if satisfactory evidence is given in "b."

AGE TWELVE MONTHS

1. SITTING AND STANDING. a. Place the child on a stool or other seat without support to the back. Note how readily or easily he maintains the sitting posture.

b. Place him on the floor away from any support and try to make him stand up unsupported.

Scoring. Passed if the child sits up unsupported for two or three minutes, or if he stands unsupported for about five seconds or more.

2. SPEECH. a. Note throughout the tests the spontaneous vocalizations of the child, their character, and number of syllables that are combined.

b. Have the mother or nurse try to make the child say the following: "Ba, dada, nan, nana, mama, papa,

man," or anything else she thinks the child can say.

c. If the child makes no response, ask the mother or nurse to describe the vocalizations the child is known to make at times, giving illustrations.

Scoring. Passed if there is satisfactory evidence that the child frequently combines two or three syllables, or tries to repeat syllables or words spoken to it, with some success.

3. IMITATION OF MOVEMENTS. a. Shake a rattle two feet in front of the child, then place it in the child's hand, then repeat the motion of your hand.

b. The child having the rattle in its hand, shake the child's hand with the rattle.

c. Repeat "a" and "b" with a small hand bell.

d. Have the mother or nurse try to make the child imitate some movement, such as nodding the head, shaking head, pursing lips, or anything else that she thinks she can make the child do.

e. Ask the mother or nurse to describe imitations the child makes at other times.

Scoring. Passed if the child unmistakably imitates in any of the instances, or if the mother or nurse can give satisfactory evidence that he does so more or less readily at other times.

4. MARKING WITH A PENCIL. a. Place a paper before the child, and about a four-inch pencil in his hand. With your own pencil make some marks on the paper, getting his attention to your marking.

b. Instead of making marks with your own pencil, take the child's hand, and with his pencil make some marks by "rubbing" on the paper. Then release his hand and note if he continues the marking.

Scoring. Passed if in either "a" or "b" the child gives evidence that he tries to mark on the paper—looks at the paper while he marks, for example—and does not merely imitate the movements the examiner makes.

5. **RECOGNITION OF OBJECTS.** a. Screen the table and things on it from the child's vision by having the mother or nurse hold a cardboard or paper in front of his eyes, while you place the following on the edge of the table within the child's reach: Ball, rattle, bell, block, colored picture, and other objects of interest to children of his age. Remove the screen and note if the child reaches for any object. If he does, replace the object on the table in a different position, while screened from his vision. Then repeat as before. Give several trials to note if he chooses the same object in most cases.

b. If a satisfactory response is not obtained in "a", repeat by taking one object in each hand, and bring both within his reach. Give several trials, and note if he shows any preference in his choice.

c. Ask the mother or nurse to give what evidence she can that the child discriminates objects, recognizes persons or shows preferences among playthings.

Scoring. Passed if there is satisfactory evidence that the child discriminates between several objects by showing preferences, or recognizes several persons by giving undoubtable signs of recognition.

AGE EIGHTEEN MONTHS

1. **DRINKING.** a. Try to make the child take a drink from a glass of water.

b. Repeat with a glass of milk.

c. Inquire of the mother or nurse whether the child ever takes several swallows in succession from a glass of water or milk.

Scoring. Passed if the child drinks, takes several swallows from a glass in immediate succession, and without pausing. Distinction must be made between mere sucking at the glass and the more complex drinking movements.

2. **FEEDING WITH SPOON OR FORK.** a. Place a bowl of

food before the child, and a spoon in his right hand. If he makes no effort to eat, let the mother or nurse take his spoon and feed him a half spoonful twice, and then replace the spoon in his hand.

b. If the child makes no effort to eat with the spoon, repeat with a fork and plate of other food.

c. If he fails to eat in both "a" and "b", ask the mother or nurse to what extent the child is able to feed himself.

Scoring. Passed if the child is in any degree successful in his effort to feed himself.

3. SPEECH. a. Ask the mother or nurse to try to make the child repeat the following after her: "Mama, papa, baby, yes, no, cat, man." Let her use any other words if she thinks they might give better success.

b. Have the mother or nurse ask the child some questions requiring a yes or no answer.

c. If the child fails to speak any word more or less distinctly in "a" or "b", ask the mother or nurse what words the child ever uses, if any, and what questions he understands.

Scoring. Passed if the child unmistakably uses some words, or understands a question without gesture.

4. SPITTING OUT SOLIDS. a. Place a bit of bread soaked in slightly weakened vinegar in the child's mouth. Repeat once or twice if the child does not remove it.

b. Ask the parent or nurse to describe how the child removes from the mouth things that are distasteful.

Scoring. Passed if the child makes some special movement to remove distasteful objects from the mouth. Simply holding the mouth open, whether the object drops out or not, is not sufficient for a pass.

5. RECOGNITION OF OBJECTS IN PICTURES. a. Show a series of large colored pictures of things most familiar to children of this age. Pictures of persons, especially babies, domestic animals, such as may be obtained from advertising pages of magazines, may serve this purpose.

Bring one at a time rather suddenly before the child, and note his reactions.

b. If the pictures fail to bring any response, ask the parent or nurse to describe any responses the child makes to pictures at other times.

Scoring Passed if the child shows marked signs of recognition or interest by gaze, or vocalization.

AGE TWO YEARS

1. POINTING OUT OBJECTS IN PICTURES. Show the first card for this test and say: **"See the pictures. Look! Show me the dog."** Then, **"Show me the man,"** or **"Where is the—?"**, for each of the pictures. Use the second card in the same way.

Scoring. Passed if the child points out correctly five of the eight pictures on the two cards.

2. IMITATION OF SIMPLE MOVEMENTS. a. Raise both arms straight up in the vertical, saying, **"Put your arms up like this."**

b. Clap hands, saying, **"Now like this."**

c. Put both palms on top of the head saying, **"Now like this."**

d. Turn the hands around each other, describing a rather large circle, saying, **"Now make them go like this."**

Scoring. Passed if in three of the four cases the child's actions are at least rough approximations of the movements made by the examiner.

3. OBEYING SIMPLE COMMANDS. a. Pick up the ball on the table, and say: **"See this ball. Look!"**, as you bounce or roll it about on the table. Then, **"Now you catch the ball."** Then roll it on the table towards the child. Then, **"Throw it back to me,"** holding your hands in readiness to catch or stop it.

b. Roll it away on the floor ten to fifteen feet, and say: **"Now get the ball and throw it to me."** As the

child picks it up, repeat: **"Throw it to me,"** making motions as if to catch it.

c. Throw it to the child, and say: **"Get the ball and put it back on the table here."**

d. If the child fails in all cases to respond, ask the parent or nurse to describe instances of the child obeying similar commands at home.

Scoring. Passed if two satisfactory responses are obtained, or if the parent or nurse gives two or more satisfactory instances. A response is satisfactory if the child shows that he comprehends and attempts to carry out the command.

4. **COPYING A CIRCLE.** a. Place a piece of paper before the child, and make one or two rough circles on it as the child watches. Then give the child a pencil and make some more circles, as you say to the child: **"You make some."** Urge and repeat a number of times if necessary.

b. Take the child's hand with the pencil in it, and make a few rough circles for him. Release his hand and say: **"Now you make some,"** imitating the motion above the paper at the same time.

Scoring. Passed if the child makes some effort, with sufficient success to show that he is trying to make a circle, in either "a" or "b".

5. **REMOVAL OF WRAPPING FROM FOOD BEFORE EATING.**

a. Say: **"Do you like candy?"** Then wrap a small piece of candy or of lump sugar in a piece of tissue paper, making sure that the child is seeing you do so. Hand it to the child and say: **"Here is a piece of candy; eat it. See if you like it."**

b. If no satisfactory response is obtained, take the wrapped piece and place a small piece in the child's mouth so he will eat it. Then repeat "a".

Scoring. Passed if in either "a" or "b" the child removes the wrapping before putting the candy or sugar in his mouth.

AGE THREE YEARS

1. **ENUMERATION OF OBJECTS IN A PICTURE.** Show the first picture for this test and say: **"Here is a picture. Tell me what you see in the picture."** If necessary, urge with: **"What do you see there? Tell me all you can find in the picture,"** and repeat. If there is still no satisfactory response, start the child by saying: **Show me the—**", naming some prominent object in the picture. After he has pointed out several things in this way, show him the second picture, and proceed as with the first.

Scoring. Passed if in any one of the three pictures the child enumerates at least three things without intervening questions or urging on the part of the examiner.

2. **POINTING OUT PARTS OF THE BODY.** Say:

- a. **"Show me your ears.**
- b. **Show me your eyes.**
- c. **Show me your mouth.**
- d. **Show me your hair."**

In all cases urge by repeating, or by changing the form of the command, if necessary to get a response.

Scoring. Passed if the child points out correctly in three out of the four instances.

3. **GIVING THE FAMILY NAME.** Ask: **"What is your name?"** If he gives his first name only, **"John,"** for example, ask: **"John what? John Smith?"**, or some other wrong name. If he still does not give his last name, say: **"You know what your name is, don't you? Now what is your name?"** Repeat and urge, if necessary.

Scoring. Passed if he gives his family name, or pronounces something recognizable as an effort to give the correct name.

4. **REPETITION OF A SENTENCE OF SIX SYLLABLES.** Say: **"Say 'Mama.' Say 'Slipper.'"** Then give the following: **"Say:**

- a. 'The dog runs after the cat.'
- b. 'The hen is on the nest.'
- c. 'I have a little dog.'"

If no response is obtained at once, repeat the same word or sentence once or twice with such variations as: "You can say, 'The dog runs after the cat', can't you? Now say, 'The dog runs after the cat.'"

Scoring. Passed if the child repeats word for word any one of the three sentences after the first reading. Any defect in pronouncing merely is not counted.

5. NAMING FAMILIAR OBJECTS. Show the child in succession the following objects, asking each time: "What is this?" or, "What do you call this?"

- a. Common door key.
- b. Closed jackknife.
- c. Penny.
- d. Watch.
- e. Ball.
- f. Pencil.

Scoring. Passed if four of the six are named correctly.

6. REPEATING TWO NUMERALS. Say: "Listen. You say '2'. Now say '3'. Now say:

- a. '6-4.'
- b. '8-5.'
- c. '3-7.'"

Read the two numerals at the rate of one per second, in each case, and be careful not to accent either. Repeat the two in the first trial once or twice, if the child does not respond at once but do not repeat for the second or third trial.

Scoring. Passed if the child repeats the two numerals after the first reading in any one of the three trials.

7. NAMING PICTURES FROM MEMORY. Place the pictures for this test numbered 1, 2, and 3 in a row before the child, in the order of their numbers from his left to his right. Point to each in order and ask: "What is this?",

or, "What do you call this?", and have him name each. If he gives a wrong name, do not correct him. If he fails to give any name at all for any one, name it for him. Repeat this once for the three pictures.

Then say: "Now shut your eyes so you can't see them," screening them from his sight at the same time with a piece of cardboard. Remove picture 1 on his left quickly, and say: "Now look which one did I take away?", removing your screen at the same time. If there is no response, urge with repetition of the same question, or with "What was it that was there?", pointing to the place where picture 1 was. Give ample time.

Repeat with pictures 4, 5, and 6, and then with 7, 8, and 9. In the second trial take away picture 5, and in the third take away picture 9.

Scoring. Passed if the child recalls correctly in two of the three trials.

8. **TRACING A SQUARE.** Place the blank for this test before the child with the dot at the top and say: "I am going to see how well you can do this just the way I do it." Then trace the square between the lines clockwise with a pencil, completing the tracing in about ten seconds, saying at the same time: "Go all around this as fast as you can go, but never go outside. Stay on the track all the time."

Then give the child another blank and a pencil and say: "Now see how well you can do that. Begin at the dot." Hold the paper down at one corner, and do not let him turn it around as he completes a side. Caution him with: "Don't go outside. Stay on the track," for the first and second time he crosses the line. After this simply urge him to go on, if he stops.

Scoring. Passed if the child traces the square without crossing the line more than four times. If the pencil mark shows at all outside the line it is counted as out.

Breaks in the line traced, or removing of the pencil do not count in the scoring.

AGE FOUR YEARS

1. **GIVING SEX.** Ask: "**Are you a little girl or a little boy**"?, in case of a girl, and, "**Are you a little boy or a little girl**"?, in case of a boy. If there is no satisfactory response, ask: "**Are you a little boy**"?, in case of a girl, and, "**Are you a little girl**"?, in case of a boy.

Scoring. Passed if any response is given indicating that the child knows his sex.

2. **REPETITION OF THREE NUMERALS.** Say: "**You say '4-8'**". Then, "**Now say:**

a. **'2-6-4.'**

b. **'7-5-3.'**

c. **'8-1-9.'**"

Read the numerals in each of the three trials at the rate of three numerals per two seconds, and without accent on any one. Make sure that you have the child's attention for each trial.

Scoring. Passed if the child repeats correctly in one out of the three trials. Changing the order is not counted as an error.

3. **COMPARISON OF TWO LINES.** Place the card for this test before the child and say: "**See the two sticks; one little one and one big one. Show me the big one.**" Give three trials, if all three responses are correct, or six trials if one of the first three is wrong. Have the longer line alternately at the top, bottom, right, left, etc., repeating for each trial, "**Show me the big one,**" or, "**Which is the big one?**"

Scoring. Passed if all the responses for the first three trials are correct, or if five out of the six are correct.

4. **DISCRIMINATION OF FORMS.** Place the large card with the ten forms for this test before the child, and place the small card with the circle of the duplicate set

of forms on the small cross in the middle of the bottom row of forms on the large card. Then say: **"Show me one like this,"** passing your finger around the circle at the same time, and then say: **"Find one like this among the others,"** passing your hand across the whole group. Use the square next, and the triangle next, and the rest in any order. Correct the first error made by the child saying: **"No, find one just like this one,"** passing your finger around the form again. Make no comment on the second or following errors, but encourage with a **"That's good,"** or similar remark several times when the choice is correct.

Scoring. Passed if seven out of the ten are chosen correctly. The first error is counted, even though the child corrects it after he is told that it is wrong.

5. TRACING IRREGULAR FORM. Place the blank for this test before the child, with the dot at the top, and say: **"I am going to see how well you can do this just the way I do it."** Then trace the form clockwise with a pencil, completing the tracing in about fifteen seconds, saying at the same time: **"Go all around this as fast as you can go, but do not go outside. Stay on the track all the time."**

Then give the child another blank and a pencil and say: **"Now see how well you can do that. Begin here at the dot."** Hold the paper down at the corner and do not let him turn it around as he completes a side. Caution him with: **"Don't go outside. Stay on the track,"** for the first and second time he crosses the line. After this, simply urge him to go on, if he stops.

Scoring. Passed if the child traces the form without crossing the line more than four times. If the pencil mark shows at all outside the line it is counted as out. Breaks in the line traced, or removing the pencil, do not count in the scoring.

6. **RECOGNITION OF FORMS.** Place the large card with the sixteen forms for this test face down before the child. Five of these forms are duplicated on five small cards. Take the last card of this duplicate set, and show it to the child for a second or less in inverted position, and say: **"I am going to show you this and see if you can find one like it among these,"** as you turn the large card with the sixteen forms face up for about five seconds.

Then show card 1 of the duplicate set for ten seconds, saying: **"Now look at this."** Watch the child's eyes and urge him with a **"Look, look!"** if his eyes wander.

After ten seconds remove the small card and turn the large card face up again quickly, saying: **"Now show me one just like it among these."** Urge with, **"Look all over. Find it,"** if necessary.

Turn the large card with the sixteen forms face down again at once after he makes a choice. Repeat with cards 2, 3, 4 and 5.

Scoring. Passed if two out of the five are chosen correctly.

7. **COMPREHENSION.** Say: **"Listen."** Then:

- a. **"What must you do when you are sleepy?"**
- b. **"What must you do when you are cold?"**
- c. **"What must you do when you are hungry?"**

Repeat the questions if necessary, and allow about twenty seconds for a response.

Scoring. Passed if there are two correct responses. A response is regarded as satisfactory if not obviously absurd or irrelevant. Silence counts for a failure.

8. **NAMING PICTURES FROM MEMORY.** Place the pictures for this test numbered 1, 2, 3 and 4 in a row before the child, in the order of their numbers from the child's left to his right. Point to each in order and ask: **"What is this?"** or, **"What do you call this?"** and have the child

name each. If he gives a wrong name do not correct him. If he fails to give any name at all, name it for him. Repeat this once for the four pictures.

Then say: **"Now, shut your eyes so you can't see them,"** screening them from his sight at the same time with a piece of cardboard. Remove picture 2 quickly, and say: **"Now look, which one did I take away?"** removing the screen at the same time. If there is no response, urge with repetition of the question and with **"What was it that was there?"** pointing to the place where picture 2 was. Repeat with picture 5, 6, 7 and 8, and again with 9, 10, 11 and 12. In the second trial take away picture 7 and in the third trial take away picture 12.

Scoring. Passed if the child recalls correctly in two out of the three trials.

AGE FIVE YEARS

1. COUNTING FOUR PENNIES. Place four pennies (or four of the weights used in other tests) before the child and say: **"See these pennies (or blocks, or boxes, as the case may be). Count them and tell me how many there are. Count them with your finger."** Unless it is evident that he has really counted them and not given the number accidentally correct, insist on his counting them with his finger. After he has made the count, ask: **"How many are there?"**

Scoring. Passed if he counts them correctly, and also answers "Four" to the last question.

2. COPYING A SQUARE. Place the card with the square for this test before the child. Give him a pen with ink and paper, and say: **"See how nicely you can make one just like this,"** pointing to the square. After he has completed one, say: **"That is fine. Now make another one."** Repeat for a third trial.

Children with marked motor disturbance interfering with their drawing may be allowed to use a pencil in-

stead of a pen. Others who persistently hold the pen in such a position that it will not write and give up the task because of this, may be assisted by showing them once how to hold the pen, but no further aid should be given. Most children who fail with a pen fail also when a pencil is substituted.

Scoring. Passed if two of the squares are as good as samples 1, 2, 3 of the sample card for this test. Failed if they are no better than samples 5, 6, 7.

3. COMPARISON OF WEIGHTS. Take the two weights for this test, the lightest and the second heaviest of the five used in IX, 2, and say: **"Here are two weights, one heavy and one light one. Lift them like this (illustrate by lifting the two successively between thumb and forefinger as if to discriminate) and give me the heavy one."** Then place them before the child, having him take them in the same way, and repeat: **"Give me the heavy one."** If he gives both, or the wrong one, say: **"No, give me the heavy one."** Give six trials, with the heavy weight alternately right, left, nearer, farther, etc., but do not correct him again after the first trial. Simply repeat for each trial: **"Give me the heavy one."**

Scoring. Passed if the heavy weight is chosen four times out of the six trials.

4. MAKING RECTANGLE WITH TWO TRIANGLES. Place the small rectangular card for this test before the child, and the two triangular cards nearer him in such a way that the longer side (not the hypotenuse) of one triangle will lie along the longer side of the other triangle, separated about an inch, and faced up so that the triangles can be put together into a rectangle without having to turn over one of them. Place your thumb and forefinger of one hand on the two triangles and say: **"Put these two pieces together (moving their longer sides together and apart once or twice) so they will make one like this"**

(pointing to the rectangular card). Give three trials, returning the cards to their original positions each time, and saying: "Try it again. Put them together so they will make one like this," or if the child has failed, say: "No, put them together so they will make one like this." Leaving them in any wrong position for half a minute counts as one trial.

Scoring. Passed if he succeeds twice in the three trials.

5. REPETITION OF A SENTENCE OF TEN WORDS. Say: "You say now what I read to you just the way I read it. Listen." Then give the following:

- a. "His name is John. He is a very good boy."
- b. "We will have a great time at the big picnic."
- c. "When the train passes you will hear the whistle blow."

If he remains silent for the first trial repeat the same sentence, adding at once, "Now, what did I say?" If he repeats it imperfectly apparently because of carelessness, say: "Say it just as I say it. Listen." Then give the second trial on the same sentence. Then give the second and third sentences, with only one reading each.

Scoring. Passed if one of the three sentences is repeated without error after one reading only. Imperfections in pronunciation are not counted as errors.

6. DEFINITION ACCORDING TO USE OF OBJECT. Ask: "Can you tell me what a fork is?" Then give the following:

- a. "What is a fork?"
- b. "What is a table?"
- c. "What is a chair?"
- d. "What is a horse?"
- e. "What is a pencil?"

If the child does not respond readily for the first one, say: "You know what a fork is, don't you?" or, "Yes,

you know what a fork is. You see one every day at the table. Now, what is a fork?"

Scoring. Passed if four out of the five are defined in terms of use, or better.

7. TAPPING BLOCKS IN IRREGULAR ORDER. Place four of the weights used in test IX, 2 in a horizontal row before the child, about two inches apart. Say: "**Watch me carefully, and then do just as I do.**" Then tap the weights with your forefinger in the following order, from the child's left to his right, and at the rate of one tap per second:

- a. 1—2—4.
- b. 1—3—4.
- c. 2—3—4.

After he is shown each, say: "**Now, you do that,**" and, "**Now, watch again,**" for the second and third trial. Make sure that you have his attention while you tap.

Scoring. Passed if the child reproduces the series without error in one out of the three trials.

8. NAMING THE PRIMARY COLORS. Show the child the four color cards for this test in the order, red, yellow, blue, green and ask for each: "**What color is that?**" or "**What do you call that?**"

Scoring. Passed if all four colors are named correctly.

AGE SIX YEARS.

1. DISTINCTION BETWEEN RIGHT AND LEFT. Say:

- a. "**Raise your right hand.**"
- b. "**Show me your left ear.**"
- c. "**Show me your right eye.**"

Speak very slowly, accent "Right" and "Left," and allow plenty of time so as to avoid a tendency to confusion. If only one error is made, repeat, this time in the order, left hand, right ear, left eye. If the child changes his response, the first response is not counted, no matter whether it was correct or wrong. Care must be taken

not to suggest such a change in any way, as by waiting too long before passing to the next.

Scoring. Passed if the first three responses are correct, or if five out of the six are correct.

2. AESTHETIC COMPARISON. Show the cards for this test in the order indicated, asking each time: **"Which is the prettier of these two?"** or, **"Which one do you like best?"**, if there is no response to the first question. If only one error is made for the three cards the first time, repeat in the same order.

Scoring. Passed if the first three responses are correct, or if five out of the six are correct.

3. DISTINCTION BETWEEN MORNING AND AFTERNOON. Ask: **"Is it morning or afternoon?"**, if it is in the morning, and, **"Is it afternoon or morning?"**, if it is in the afternoon.

Scoring. Passed if the correct answer is given more or less promptly.

4. RECOGNITION OF MUTILATION IN PICTURES. Show the pictures for this test in their order, saying for the first one: **"See this picture. What is gone in that face?"** For the remainder say simply: **"What is gone there?"**

If the child does not at once understand for the first picture, or gives a wrong reply, repeat the question in varied form. If necessary, proceed as follows. Say: **"You see the eyes. Look, the eyes are there. You see the nose. Yes, the nose is there; and, look, the chin is there. Now, what is gone?"** Point to each part as you proceed. If he still fails to respond correctly, add: **"Look, the mouth is gone, is it not? Yes, the mouth is gone."** Do this only for the first picture. For the others ask only the one question given.

Scoring. Passed if the responses are correct for three out of the four pictures. Any response is regarded as

correct if it shows clearly that he recognizes what part is gone.

5. **EXECUTION OF THREE SIMULTANEOUS COMMANDS.** Having arranged things beforehand, say: "You see that chair there. Go put that chair over there against the wall. Then put this key (or other object) on that chair. Then close (or open) the door. First the chair against the wall. Then the key on the chair. Then close the door. Go ahead."

If the child starts at once to do the first thing before he is told about the others, as he very often does, add: "Now, wait, wait," and repeat from the start. The three things to be done may be varied, if circumstances require it, but great care must be taken to have them very similar, and to give the directions in a very similar manner.

If the child stops at any point, looks at the examiner in an inquiring manner, or as if for approval, he should simply be urged to "Go on."

Scoring. Passed if the child does the three things, in any order, without further help or suggestion from the examiner.

6. **COUNTING IRREGULAR SERIES OF FOUR TO SIX TAPS.** Say: "I am going to tap on the table and see if you can count the number of taps. You must count to yourself and give me the number when I ask you." Then tap the first series given for illustration, one tap for each dot, while carefully screening the movements of your hand and arm from the child's sight with a large cardboard.

Then say: "Now, sometimes I will stop tapping and then begin again. Don't let that fool you. You count only those you hear. Now, listen; begin with one again." Then tap the remaining series in order at the rate of one square per second, tapping once for each dot, and pausing a second for each blank square. Tap rather

loudly with the blunt end of a pencil, or with the edge of a coin.

| Illustration | . | . | . | . | . | | | | 5 |
|--------------|---|---|---|---|---|---|---|---|---|
| a | . | . | | . | . | | | | 4 |
| b | . | | . | . | | . | . | . | 6 |
| c | . | . | . | | . | | | | 4 |
| d | . | . | | . | . | . | | . | 6 |
| e | . | | . | . | | . | | . | 5 |

Scoring. Passed if three out of the five series are counted correctly. The illustration series is not counted.

7. FOLDING A SQUARE OF PAPER THREE TIMES. Take a six-inch square of paper prepared for this test, and say: "I am going to fold this piece of paper and see if you can fold this other one (showing him a second piece) just like it. Now, watch."

a. Then, facing the child, fold your lower left corner of the square onto the upper right corner, making a triangle. Then fold the lower corner onto the upper right corner. Then fold the corner on the left onto the upper right corner, making a square.

Then say: "Now, you make this one just like it," giving him the second piece. Put one of the weights used in test IX, 2 on your folded piece to hold down the edges while the child is folding.

b. Say: "Now, we will try another. Watch again." Fold your lower left corner onto the upper right corner. Then fold the upper right corner of the upper sheet only back onto the center of the opposite side. Then fold the corner on the left onto the lower corner making a right-angled triangle.

Give the child the second piece of paper and say: **"Now, make this one just like it."**

In both "a" and "b" do the folding in about twenty seconds, being careful not to hide the operation with your hands. Watch the child, and if his attention wanders, say, **"Watch me, watch me all the time."**

Record the time it takes the child to do the folding and the number of errors he makes for each trial. If he gives up before he has completed three folds urge him to go on until he has tried for a total of 80 seconds. Count the errors always as three minus the number of folds he has made correctly, irrespective of the order of the foldings, at the end of the 80 seconds as the maximum time to be allowed, excepting that any extra folds made after the three correct ones are counted as errors.

Scoring. Use the average time (T) for the two trials, and the total number of errors for the two trials (E). The test is then passed if $\frac{T}{60} + E = 1.5$, or less.

8. TAPPING BLOCKS IN IRREGULAR ORDER. Place four of the weights used in test IX, 2 in a horizontal row before the child, about two inches apart. Say: **"Watch me carefully, and then do just as I do."** Then tap the weights with your forefinger in the following order, from the child's left to his right, and at the rate of one tap per second.

- a. 1—3—2—4.
- b. 1—4—3—2.
- c. 1—4—2—3.

After tapping each series, say: **"Now, you do that."**

Before tapping the second and third series, say: **"Now, watch again."** Make sure that you have the child's attention while you tap.

Scoring. Passed if the child reproduces the series without error in two out of the three trials.

AGE SEVEN YEARS.

1. **DESCRIPTION OF PICTURES.** Show the first picture for this test and say: **"Look at that picture. Tell me what that picture is about."** If there is no response, or only enumeration, change the question to: **"What is that a picture of?"** If there is still no satisfactory response, say: **"Tell me what you see in the picture,"** but do this only for the first one. Use all three pictures unless satisfactory responses are obtained for the first two.

Scoring. Passed if the responses for any two of the pictures are better than mere enumeration of things in the picture.

2. **NAMING THE FIRST FOUR COINS.** Show the child the coins in the following order:

- a. Nickel.
- b. Quarter.
- c. Dime.
- d. Penny.

Ask for each: **"How much is this?"** If only one coin is named wrongly, repeat the series.

Scoring. Passed if all four coins are named correctly in the first or second trial.

3. **TELLING THE NUMBER OF FINGERS.** Ask the following:

- a. **"How many fingers on your right hand?"**
- b. **"How many fingers on your left hand?"**
- c. **"How many in all on the two hands?"**

Scoring. Passed if the three responses are all given without much hesitation or any counting, and are "Five, Five, Ten, or Four, Four, Eight."

4. **REPETITION OF FIVE NUMERALS.** Say:

"I am going to read you some numbers. Now, listen very carefully and see if you can say them when I get through just the way I read them. Listen." Then give the following, reading them very distinctly at the rate of

five per three seconds, being very careful to avoid all accents and rhythm:

- a. "6—5—2—8—1."
- b. "4—9—3—7—5."
- c. "2—8—6—1—9."

For the second and third trial say simply: **"Now, this one. Listen."** Frequently verify your rate of giving the numerals with a watch.

Scoring. Passed if the child repeats one of the three series without error. Changing the order of the numerals, simply, is not counted an error.

5. **COMPARING TWO OBJECTS FROM MEMORY.** Ask the following in order: **"What is the difference between:**

- a. **A fly and a butterfly?**
- b. **Wood and glass?**
- c. **A stone and an egg?"**

If the child does not at once understand what is wanted, say: **"You have seen butterflies. You know what a butterfly is. And you know flies. Are they alike? Why are they not alike?"** For the last two trials simply urge by repeating the original question once or twice, if necessary.

Scoring. Passed if the child points out some real difference in two out of the three trials.

6. **GIVING WORD OPPOSITES.** Say: **"I am going to give you a word and see how quickly you can think of another word that means just the opposite. For instance, if I say 'Full' you must say 'Empty.' If I say 'Poor' you must say 'Rich.' If I say 'Black' you must say 'White,' and so on, as fast as you can go. Now, what do you say when I say 'Full'?"** Repeat same for "Poor" and "Black," giving him the correct word again if he fails. Then give the list of ten words, giving him the correct word for the first three if he fails.

For the first three words of the test repeat the question each time, **"What do you say when I say —?"** For the

remainder simply give the word without the question, or say: "Now this one, listen," for two or three words more, if necessary.

- | | |
|--------------|-------------|
| a. "Cold." | f. "Slow." |
| b. "Little." | g. "Thick." |
| c. "Bad." | h. "Soft." |
| d. "Up." | i. "Dry." |
| e. "Short." | j. "In." |

Take special care to pronounce each word very distinctly, and allow ample time between trials (the time the examiner needs to record for each word is about correct). The test can be given fairly accurately with an ordinary watch, but a stop-watch is desirable. Record the "association time" for each word in the nearest whole number of seconds. Count it an error if the word given by the child is not a true opposite in meaning, or if he takes more than ten seconds. At the end of ten seconds for any word, give the child the correct word, as for example, "'Warm,' when I say 'Cold,' you must say 'Warm.'"

Scoring. Use the average time (T) for the ten words, not counting those that took more than ten seconds and for which an error was recorded, and the total number of errors (E). The test is then passed if $T + E = 5$, or less.

7. REPEATING THREE NUMERALS BACKWARDS. Say: "I am going to read you some numbers, and when I am through I want you to say them backwards. If I should say '1—2—3,' you must say '3—2—1.' Now, listen carefully, so you will be able to say them backwards." Explain further after the first of the following three trials, if necessary, but no more. Read the numerals at the rate of one per second.

- a. "2—8—3."
- b. "4—1—7."
- c. "5—9—6."

Scoring. Passed if the numerals are repeated backwards correctly in one out of the three trials.

8. **COPYING A DIAMOND.** Place the card for this test before the child, give him a pen with ink and a piece of paper, and say: **"See how nicely you can draw a diamond just like this one."** Give three trials, unless the first two are satisfactory. Urge with praise and other appropriate comments, if necessary. If the child is unusually nervous or has some other serious motor disturbance, substitute a pencil for the pen and ink.

Scoring. Passed if in two out of the three trials the child's drawings are as good or better than samples 1, 2, 3 given on the sample card for this test. Samples 4, 5, 6 are unsatisfactory.

AGE EIGHT YEARS

1. **COUNTING THE VALUE OF STAMPS.** Place the card for this test before the child and say: **"How much will it cost to buy all these."** If the correct answer is not given after ample time, ask: **"How much is one of the green ones worth?"** Then, **"How much is one of the red ones worth?"** Give him the correct values if he does not know. Then ask: **"Now, how much are they worth altogether?"** Give no further aid.

Scoring. Passed if he gives the correct answer after the first or last question.

2. **SIZE OF VOCABULARY.** Say: **"I want to find out how many words you know. Listen, and when I say a word you tell me what it means."** Then give as many of the following list as is necessary. They are roughly arranged in the order of difficulty:

- | | | | |
|--------------|---------------|-----------------|----------------|
| 1. Orange. | 14. Copper. | 26. Noticeable. | 39. Crunch. |
| 2. Bonfire. | 15. Health. | 27. Muzzle. | 40. Juggler. |
| 3. Roar. | 16. Curse. | 28. Quake. | 41. Majesty. |
| 4. Gown. | 17. Guitar. | 29. Civil. | 42. Brunette. |
| 5. Tap. | 18. Mellow. | 30. Treasury. | 43. Snip. |
| 6. Scorch. | 19. Pork. | 31. Reception. | 44. Apish. |
| 7. Puddle. | 20. Impolite. | 32. Ramble. | 45. Sportive. |
| 8. Envelope. | 21. Plumbing. | 33. Skill. | 46. Hysterics. |
| 9. Straw. | 22. Outward. | 34. Misuse. | 47. Mars. |
| 10. Rule. | 23. Lecture. | 35. Insure. | 48. Repose. |
| 11. Haste. | 24. Dungeon. | 36. Stave. | 49. Shrewd. |
| 12. Afloat. | 25. Southern. | 37. Regard. | 50. Forfeit. |
| 13. Eyelash. | | 38. Nerve. | |

Question as follows: "What is an orange?" or, "Orange, what is an orange?" and "Roar, what does roar mean?" If the child hesitates, say: "You know what a — is. You have seen a—. Now what is a—?" If the response does not indicate whether he knows the meaning, say: "I don't understand. Explain what you mean." Encourage frequently, if he shows hesitation in responding.

Scoring. Passed if the responses for twenty of the words in the list show that he knows the meaning. The form of the definition is not considered. An illustration or remark about the word which shows that he knows the meaning is satisfactory.

3. COUNTING BACKWARDS FROM TWENTY TO ONE. Say: "Let me see how well you can count backwards from twenty to one. You begin with twenty and count back to one." If he hesitates, say: "Count like this: 'Twenty, nineteen, eighteen,' and so on. Now begin, 'Twenty' —."

Scoring. Passed if the count is made within twenty seconds and with not more than one error. Errors corrected by the child are not counted. Thirty seconds are allowed if the counting is done with evidence of care and effort and without any uncorrected errors.

4. **COMPREHENSION.** Give the child a sheet of the blank squares and a pencil. Point with your pencil to one and say: "See this square. This is the center of the square. What is it? This is the upper right corner of the square. What is it?" Have him repeat, and correct him if he repeats wrongly. Using the same square, proceed in the same way for the lower left corner; the middle of the left side, the middle of the lower side, and again for the center. Then give the following:

"Draw a straight line from the center of the square (pointing to the center with your pencil) to:

- a. The upper left corner.
- b. The middle of the left side.
- c. The lower right corner.
- d. The middle of the upper side.
- e. The upper right corner.
- f. The middle of the lower side.

Speak slowly, and repeat the last part of each (beginning with "from the center to—," etc.) once. Point out the center of the square again for "a" and "b" if necessary, and draw the line correctly for him, with explanation, for the first two trials, if he fails. Give no further help in following trials, except to urge by repeating the last part of each a second or third time.

Scoring. Passed if he draws the line correctly in four out of the six trials.

5. **GIVING WORD OPPOSITES.** Say: "I am going to give you a word and see how quickly you can think of another word that means just the opposite. For instance, if I say 'Full,' you must say 'Empty.' If I say 'Poor,' you must say 'Rich.' If I say 'Black,' you must say 'White,' and so on, as fast as you can go. Now, what do you say when I say 'Full'?" Repeat same for "Poor" and "Black," giving him the correct word if he fails. Then

give him the list of ten words, giving him the correct word for the first three if he fails. For the first three repeat the question each time, "What do you say when I say——?" For the remainder simply give the word without question, or say: "Now, this one, listen," for two or three more, if necessary.

- | | |
|------------|-----------|
| a. Cold. | f. Slow. |
| b. Little. | g. Thick. |
| c. Bad. | h. Soft. |
| d. Up. | i. Dry. |
| e. Short. | j. In. |

Take special care to pronounce each word very distinctly, and allow ample time between trials (the time the examiner needs to record for each word is about correct). The test can be given fairly accurately with an ordinary watch, but a stop-watch is desirable. Record the "association time" for each word in the nearest whole number of seconds. Count it an error if the word given by the child is not a true opposite in meaning, or if he takes more than ten seconds. At the end of ten seconds for any word give him the correct word, as for example, "Warm; when I say 'Cold' you must say 'Warm.'"

Scoring. Use the average time (T) for the ten words, not counting those that took more than ten seconds, and for which an error was recorded, and the total number of errors (E). The test is then passed if $T + E = 3$, or less.

6. GIVING SIMILARITIES. Say: "I am going to name two things which are alike in some way, and I want you to tell me in what way they are alike." Then give the following pairs, asking for each: "In what way are they alike?"

- a. "Wood and coal."
- b. "An apple and a peach."

c. "Iron and silver."

d. "A ship and an automobile."

A little urging is often necessary, by repeating the question, or with such variation as "— and — are alike in some way, aren't they? In what way?" If a difference instead of a likeness is given, say: "Yes, that is the way they are different, but now in what way are they alike?"

Scoring. Passed if a likeness is given in two out of the four trials. Any real likeness pointed out is satisfactory. A negative quality, that is, something that neither possesses, is not regarded as a likeness.

7. FOLDING A SQUARE OF PAPER FIVE TIMES. Take a six-inch square of paper prepared for this test and say: "I am going to fold this piece of paper and see if you can fold this other one just like it (showing him a second piece). Now, watch."

a. Then, facing the child, fold your upper right corner of the square onto a cross you have made at the center. Then fold the lower edge onto the center, so that the right half of this edge will meet the edge of the part folded first. Then fold the upper left corner onto the cross at the center as in the first folding. Then fold the left edge onto the right edge. Then fold the corner at the top onto the lower left corner, making a rectangular piece with a truncated upper corner. Then say: "Now, you make one just like this," giving him a second square. Put one of the weights used in test IX, 2 on your folded piece to hold down the edges while the child is folding.

b. Say: "Now, we will try another one. Watch again." Fold your upper right corner onto the cross you have made at the center. Then fold the lower left corner onto the cross at the center. Then fold the lower side onto the upper side so that what was the lower right half

of the lower edge will now continue the left half of the upper edge in a straight line, making a perfect rectangle. Then fold the upper left corner onto the middle of the lower edge of the rectangle. Then fold the corner on the left onto the lower right corner, making a square. Give the child the second piece of paper and say: **"Now, you make one just like this."**

In both "a" and "b" do the folding in about thirty-five seconds, being careful not to hide the operations with your hand. Watch the child, and if his attention wanders, say: **"Watch me, watch me all the time."** Record the time it takes the child to do the folding, and the number of errors he makes for each trial. If he gives up before he has completed five foldings, urge him to go on until he has tried for a total of 100 seconds. Count the errors always as five minus the number of folds that he has made correctly, irrespective of the order of the foldings, at the end of 100 seconds as the maximum time allowed, excepting that any extra folds made after the five correct ones are counted as errors.

Scoring. Use the average time for the two trials (T) and the total number of errors for the two trials (E). The test is then passed if $\frac{T}{100} + E = 3.7$, or less.

8. COUNTING DOTS. Give the child the card for this test and say: **"See how fast you can count the dots in each of the squares on this card. You count to yourself, but give me the number in each square out loud. You begin here** (pointing to the square in the upper left corner of the card) **and count each row of squares from left to right** (moving your finger along the first and second rows from left to right). **I want to see how fast you can do this without making any mistakes in the count. Be sure not to make any mistakes in the count. Now, begin here"** (pointing to the first square).

If a second error is made in the first row of squares, caution him by saying: "Be careful. Don't make any mistakes."

Follow the count with your "key" card, giving the number of dots for each square. Record the number of squares counted wrongly (E), and the total time for counting all the squares (T).

Scoring. Passed if $\frac{T}{10} + 5E = 26$, or less.

AGE NINE YEARS.

1. GIVING THE DATE. Ask the following:
 - a. "What day of the week is this?"
 - b. "What month is it?"
 - c. "What day of the month is it?"
 - d. "What year is this?"

If the day of the month is given for "a" or some other misunderstanding occurs, as is occasionally the case because of lack of attention, repeat your question, with explanation, if necessary.

Scoring. Passed if all are answered correctly, excepting the day of the month, for which an error of three days is allowed.

2. ARRANGEMENT OF WEIGHTS. Place the series of five weights for this test before the child and say: "Here are some weights. They do not all weigh the same. Some are heavy and some are light, and no two are just alike. Lift them like this (lift several in succession between thumb and forefinger) and find the heaviest one." Having designated his choice, say: "Good. Put it here (pointing to a place several inches in front of the rest) and then find the next heaviest and put it here, in a row with this one." The second weight being chosen, say: "Now, the next heaviest, and put it in a row with these two, and so on." Point to the place each time, if necessary. Give no further direction, except to urge by saying, "Go on," if necessary. Give three trials, unless the first two

are correct. For the second trial, say: "That is good. See if you can do it again. First the heaviest, then the next heaviest, and so on, all in a row." For the third trial say simply, "Now, once more." Mix the weights well before each trial.

Scoring. Passed if the weights are arranged in correct order two times in three trials.

3. USING THREE WORDS IN A SENTENCE. Say:

"Here are three words, 'Money, river and St. Paul' (repeating them once slowly). Make a sentence in which you use these three words."

If he fails entirely to understand what is to be done, or makes no reply, give the following illustration after one minute: "If I gave you the words, 'Spring, bloom and flowers,' you might say: 'The flowers bloom in Spring.' Now use the words 'Money, river and St. Paul, that way in a sentence.'" Give one-half minute more for a response.

If within the first minute the words are used in three separate sentences, or in three sentences connected by "and," say: "Good. Now see if you can put all three words in just one sentence," and allow another half-minute.

The name of some other prominent town may be substituted for "St. Paul," also "Lake" for "River," in States where such a change would present a more familiar situation to the child.

If a correct answer is given at once without hesitation, or if there is other reason for supposing that he has been coached on this test, use the words, "Trees, house, work," or, "Summer, man, rain" in place of the above.

Scoring. Passed if the child gives a sentence correct in English with the three words in it in not more than two clauses and within the minute and a half allowed.

4. MAKING CHANGE. Say: a. "If I bought a pencil

for four cents and gave the clerk ten cents, how much money would I get back?"

b. "If I bought a slate for ten cents and gave the clerk twenty-five cents, how much money would I get back?"

c. "If I bought some candy for twelve cents and gave the clerk fifteen cents, how much money would I get back?"

Repeat the problem at any time it seems necessary. The answers must be given without aid of pencil or other help.

Scoring. Passed if two out of the three are answered correctly.

5. DEFINITION BETTER THAN ACCORDING TO USE. Ask the following: "What is a :

- a. Balloon?
- b. Telephone?
- c. Football?
- d. Tiger?
- e. Soldier?"

If for any word there is no reply, urge by saying: "You know what a — is. You have seen a —. Now what is a — like?"

If the response for the first word is unsatisfactory, say: "Yes, now tell me all about a balloon. What sort of a thing is it?" Do the same for telephone, but for the remainder adhere to the question, "What is a — ?" simply.

Scoring. Passed if for three of the words definitions are given better than according to use. (See comments on this test in next chapter for kinds of definitions usually given and their classification. Page 174.)

6. COMPREHENSION. Give the child a sheet of the blank circles used for this test and a pencil, and say: "See this dot at the center of the circle?" (Point to one with your

pencil). Then give the following, speaking very slowly:

"Draw a square on that circle so that the:

- a. **Upper left corner**
- b. **Middle of the right side**
- c. **Lower left corner**
- d. **Middle of upper side**
- e. **Upper right corner**
- f. **Middle of lower side**

of the square will be at the center of the circle." Give one at a time, and repeat each one once, unless obviously unnecessary. If he does not understand, or draws wrongly for the first one, draw it for him, after thirty seconds, and explain fully as follows: First draw a small square above the circle. Then say: **"Now, we will draw this square on this circle so that the upper left corner of the square will be at the center of the circle, like this."** Then draw the square, and so that its upper right corner will be at the dot in the circumference on the right, and its lower left corner at the dot in the circumference at the bottom, its upper left corner being then at the dot in the center of the circle. Then add: **"Now this is the upper left corner of the square (pointing to it). See? And it is at the center of the circle."**

If the child does not understand, or draws wrongly for the second trial, draw this for him also, and go through the same procedure as in the first.

Give no further aid for the remaining trials, other than simply to repeat the directions once. Record the time it takes him to draw the square in each case, counting from the end of your repetition of the direction, but do not allow over thirty seconds for any trial. If at the end of this thirty seconds a correct drawing is not completed, count it an error, and record thirty seconds for the time. Compute the average time (T) for the six trials, and

record the total number of trials in which he failed (E).

Scoring. Passed if $\frac{T}{5} + E = 7$, or less.

7. REPEATING FOUR NUMERALS BACKWARDS. Say: "I am going to read you some numbers, and when I am through I want you to say them backwards. If I should say '1—2—3—4,' you must say '4—3—2—1.' Now, listen carefully, so you will be able to say them backwards."

Explain further after the first of the following three trials, if necessary, but no more. Read the numerals at the rate of one per second.

a. "6—4—2—8."

b. "5—9—3—7."

c. "3—6—2—9."

Scoring. Passed if the numerals are repeated backwards correctly in one out of the three trials.

8. COUNTING DOTS. Give the child the card for this test and say: "See how fast you can count the dots in each of the squares on this card. You count to yourself, but give me the number in each square out loud. You begin here (pointing to the square in the upper left corner of the card), and count each row of squares from left to right (moving your finger along the first and second rows in this direction). I want to see how fast you can do this without making any mistakes in the count. Be sure not to make any mistakes in the count. Now begin here" (pointing to the first square). If a second error is made in the first row of squares, caution him by saying: "Be careful. Do not make any mistakes."

Follow the count with your "key" card, giving the number of dots for each square. Record the number of squares counted wrongly (E) and the total time for counting all the squares (T).

Scoring. Passed if $\frac{T}{10} + 5E = 20$, or less.

AGE TEN YEARS.

1. **DRAWING DESIGNS FROM MEMORY.** Take the card for this test and say: **"I am going to show you this card (showing it face up just an instant, less than a second) for ten seconds, and then see how well you can draw what is on it from memory. Now, ten seconds is not very long, so you will have to notice pretty carefully just how it is."** Then give him a paper to draw on, show the card for ten seconds; then turn it face down and give him a pencil immediately, and say: **"Now, draw what you saw."**

Scoring. Passed if one of the designs is drawn correctly and the other about half correct. Small errors that might be due merely to roughness of drawing are not counted. Not placing the inner rectangle in the design on the right to the right of the center is not counted an error. Placing one or both of the squares in the design on the left turned away from the center instead of towards it, or not having the central part of the correct relative height, or other similar degree of defect, are still counted as "Half right." Correct means substantially correct, all the parts there, and none added. Less than half correct means more than one part of the design substantially wrong.

2. **COUNTING DOTS.** Give the child the card for this test, and say: **"See how fast you can count the dots in each of the squares on this card. You count to yourself, but give me the number in each square out loud. You begin here (pointing to the square in the upper left corner of the card) and count each row of squares from left to right (moving your finger along the first and second rows in this direction.) I want to see how fast you can do this without making any mistakes in the count. Be sure not to make any mistakes in the count. Now, begin here" (pointing to the first square).** If a second error is made in the first row of squares, caution him by saying: **"Be careful. Don't make any mistakes."**

Follow the count with your "key" card, giving the number of dots for each square. Record the number of squares counted wrongly (E), and the total time for counting all the squares (T).

Scoring. Passed if $\frac{T}{10} + 5E = 15$, or less.

3. SPELLING FAMILIAR WORDS BACKWARDS. Say: "I am going to give you some words and see how fast you can spell them backwards." Then give words from the following lists until five trials are secured from each of the two lists. Allow not more than sixty seconds for a word. If he fails, have him spell it forwards, and if he cannot readily spell it correctly forwards, count it out as no trial, unless his ways of spelling it forwards and backwards agree and he has not made a shorter word out of it. In the latter case, count it as correct. Record the time for each word and the number of trials on which he fails.

- | | | | |
|-------------|-------------|--------------|--------------|
| 1. Almost. | 11. Winter. | 1. Another. | 11. Brought. |
| 2. Pencil. | 12. Answer. | 2. Picture. | 12. Because. |
| 3. Around. | 13. Bought. | 3. Outside. | 13. Against. |
| 4. Become. | 14. People. | 4. Instead. | 14. Chicken. |
| 5. Finger. | 15. Before. | 5. Already. | 15. Whistle. |
| 6. Ground. | 16. Minute. | 6. Country. | 16. Janitor. |
| 7. Behind. | 17. Coming. | 7. Counter. | 17. Trouble. |
| 8. Single. | 18. Sunday. | 8. Brother. | 18. Surface. |
| 9. Income. | 19. Member. | 9. Tonight. | 19. Morning. |
| 10. Prince. | 20. Engine. | 10. However. | 20. Nothing. |

Compute the average time for a word (T) and count the total number of words on which he failed in the ten trials counted (E).

Scoring. Passed if $\frac{T}{5} + E = 7$, or less.

4. COUNTING IRREGULAR SERIES OF NINE TO TWELVE TAPS. Say: "I am going to tap on the table and see if you can count the number of taps. You must count to

yourself, and give me the number when I ask you." Then tap the series given for illustration, a tap for each dot, carefully screening the movements of your hand and arm from the child's sight with a large cardboard. Then for the second series say: "Now, I will not always tap regularly as I did this time, but irregularly; first, fast, then, slow, and all mixed up. Be careful to count just those you hear, no more or less. Now, listen. Begin with one again." Then tap the remaining series in order at the rate of one square per second, tapping once for each dot, and pausing a second for each blank square. Tap rather loudly with the blunt end of a pencil or with the edge of a coin.

| | | | | | | | | | | | |
|--------|---|-----|----|-----|----|----|-----|----|----|----|----|
| Illus. | . | . | . | . | . | . | . | . | . | . | 10 |
| a | . | . | . | | . | .. | . | | . | . | 9 |
| b | . | . | .. | . | | . | . | | .. | . | 10 |
| c | . | | . | ... | . | | . | .. | . | .. | 12 |
| d | . | .. | . | | . | . | ... | | . | . | 11 |
| e | . | ... | . | | .. | . | | . | .. | . | 12 |

Scoring. Passed if three out of the five series are counted correctly, not counting the one given for illustration.

5. DETECTION OF ABSURDITIES IN ABSURD STATEMENTS. Say: "I am going to read you something that has some nonsense in it. Listen carefully and tell me what you think of what I read." Then read the following slowly and with expression, asking after each: "What do you think of that?"

a. "A little boy said, 'I have three brothers—Paul, Ernest and myself.'"

b. "A bicycle rider, being thrown from his bicycle in an accident, struck his head against a stone and was instantly killed. They took him to the hospital, but they do not think that he will get well again."

c. "A man said 'I know a road from my house to the city, which is down hill all the way to the city, and down hill all the way back home.'"

d. "Yesterday the police found the body of a young girl cut into eighteen pieces. They say that she killed herself."

If for any one the child remains silent, repeat the statement or the question, "What do you think of that?" or change to "What is the matter with that?" If the response given leaves doubt as to whether he recognizes the absurdity, ask him to explain in a manner appropriate to the nature of the response.

Scoring. Passed if the absurdity is recognized in three of the four statements.

6. GIVING THE ASSOCIATED NUMBERS FOR THE DISSECTED PARTS OF A SIMPLE FORM. There are two 6 x 8 inch cards, each with forms on both sides, for this test. Show the first card marked 1 for the test and say: "See these four lines crossing with the letters in the corners and parts. Here is 'a', 'b', 'c', down through on your left; 'd', 'e', 'f', down through the middle; and 'g', 'h', 'i' down through on your right" (pointing to the letters in order).

Then place the second card, marked 2, in front of the first and say: "Now here are the parts, but the letters are not there. What letter goes into this one?" (Point to the first part in the upper left corner of this card.) If he does not understand at once what is meant, explain in any manner necessary, and have him in this way give the letters for the first five parts, taking them in reading order on the card, while he has both cards before him. Do not hurry him, and make sure that he understands.

Then place the third card (opposite side of the first card) and marked 3 in place of the first and say: "Here is the same thing, only it has numbers instead of letters. I am going to see in a moment how fast you can give me the numbers for these parts (pointing again to the second card) after I take away this card with the numbers so you can't see it."

Then remove the second card and say: "So look carefully at these numbers first and see how they go." Give him thirty seconds for this, and then replace the third card with the fourth (opposite side of the second, and marked 4), and say: "Now, do this carefully and get each number just right. What number goes in here?" (pointing to the first part in the upper left corner of the fourth card). Point to each in reading order as he gives the numbers. If he obviously guesses at the numbers, caution him after the second error with: "Be careful. Take your time for each and get it right."

Use the "key" card in following the responses. Record the number of parts for which the wrong numbers are given (E) and the total time (T) for the nine parts.

Scoring. Passed if $5 \left(\frac{T}{3} + 10E \right) = 340$, or less.

7. **CROSSING OUT Q, R, S, T IN A MIXED TEXT.** Place the sheet for this test before the child and say: "Here is a sheet of paper with the alphabet on it all mixed up. I am going to see how fast you can cross out all the q's, r's, s's and t's. You cross out a q like this, an r like this, an s like this, and a t like this. (Show him in an illustration with the four letters at the top of the sheet by crossing out the q with a vertical stroke, the r with a horizontal one, the s with a diagonal one inclining to the right at the top, and the t with a diagonal one inclining to the left at the top). Notice carefully how you are to cross out each letter, so you won't have to look up so often to see."

Then give him thirty seconds to memorize this. Then give him a pencil and say: **"Now, take one line at a time, always from left to right (passing your pencil over a line or two in this direction) and cross out all four letters as you go along. Don't go back to cross out any letters that you may have skipped. Begin."**

Watch him for the first line and call his attention to every error made, letter skipped, letter crossed out wrongly, and wrong letter crossed out, and have him correct them. Give no further direction after this. Record the total time that it takes him for the sheet (T) and the total number of errors (E), counting all three classes together, and including any he may have corrected by your direction in the first line. Errors corrected by himself are not counted.

A convenient way to determine the number of errors made is to count the number of letters he crosses out correctly while he is working, keeping a separate count of the wrong letters that he crosses out. Then subtract the number he crossed out correctly from fifty and add to this remainder the number of wrong letters he crossed out.

Scoring. Passed if $\frac{T}{5} + 5E = 128$, or less.

8. GIVING WORD OPPOSITES. With the card for this test in your hand in inverted position, say: **"I have twenty words here. I am going to see how fast you can begin with the top one and give me a word for each word you see here that means just the opposite. We will try it first with these five words on this card."** Then give the five trial words, using them in any way necessary to make plain how it is to be done. He is simply to pronounce the opposites out loud and not the words on the card.

Then place the list of twenty before him, face down, and say: **"Now, we will try these. If you come to any word for which you cannot find an opposite, keep on try-**

ing until I say 'Next,' and then go on to the next word at once. (Allow ten seconds for any such word). **Ready.**" Then, after about a second, turn the card face up. Follow him with the duplicate list of words supplied for the examiner. Record the total time for the twenty words, and the total number of errors (E), counting as errors words given that are not opposites, and words skipped when told to skip by the examiner, or otherwise. Compute the average time for a word (T) by dividing the total time by twenty, counting the time for the words skipped.

Scoring. Passed if $30(T + E) = 280$, or less.

AGE ELEVEN YEARS.

1. WORDS TO PUT IN ORDER TO MAKE A SENTENCE. Show the first card for this test and say: "**Here are some words of a sentence all mixed up. See if you can change them around so they will make a sentence and mean something.**" If he does not succeed in two minutes, give him the following help: "**We started**"—— (Pause). "**We started for the park**——(Pause) **at an early hour. We started for the park at an early hour.**" Give this very slowly and show him the words in the lines as you give them to him. Then give the other two trials without further help, except that his attention may be called to any slight error in his sentence, such as the omission or alteration of a word. He may then be allowed to correct this error and receive credit for the trial if he uses no more than two minutes altogether for the sentence.

Scoring. Passed if two sentences are given correctly, using all the words, without alteration or addition, in two minutes each.

2. REPEATING ONE OR TWO SENTENCES WITH TWENTY-FOUR SYLLABLES. Say: "**I am going to read you long sentences. See if you can repeat them, word for word, just as I read them.**" Then give the following:

a. "Children, it is necessary to work for a living. You must go to your school every morning."

b. "When the train crosses the road, the engineer will blow the whistle and the fireman will ring the bell."

c. "The apple tree makes a cool shade on the ground where little boys and girls play on the hot summer days."

If he fails in the first sentence by only a slight error of a word or so, say: "Say it just as I say it, word for word," and then give a second trial on the same sentence, in order to impress him with the fact that no change of any sort is permissible.

Scoring. Passed if one of the three sentences is repeated without error after one reading.

3. GIVING DEFINITIONS OF ABSTRACT TERMS. Say: "Can you tell me what 'pity' means?" Then ask the following: "What is:

- a. Pity?
- b. Bravery?
- c. Charity?
- d. Revenge?
- e. Justice?"

If a word is defined in terms of itself, as "Pity is to pity someone," say: "Yes, and what is it to pity anyone?" If there is no response, urge with: "You know what—— is, don't you?" or "You have heard that word before, haven't you? What does it mean?"

Scoring. Passed if three of the five words are defined satisfactorily. A definition is satisfactory if it indicates simply that the meaning of the word is really understood. Formal or logical definitions are not required, and a correct illustration is accepted in place of a definition.

4. GIVING THE ASSOCIATED NUMBERS FOR THE DISSECTED PARTS OF A SIMPLE FORM. There are two 6 x 8 inch cards, each with forms on both sides, for this test. Show the first card, marked 1, for the test and say: "See

these four lines crossing with the letters in the corners and parts. Here is 'a', 'b', 'c', down through on your left; 'd', 'e', 'f', down through the middle, and 'g', 'h', 'i', down through on your right" (pointing to the letters in order).

Then place the second card, marked 2, in front of the first and say: "Now, here are the parts, but the letters are not there. What letter goes into this one?" (Point to the first part in the upper left corner of this card). If he does not understand at once what is meant, explain in any manner necessary, and have him in this way give the letters for the first five parts, taking them in reading order on the card, while he has both cards before him. Do not hurry him, and make sure that he understands.

Then place the third card, marked 3 (opposite side of the first card) in place of the first and say: "Here is the same thing, only it has numbers instead of letters. I am going to see in a moment how fast you can give me the numbers for these parts (pointing again to the second card) after I take away this card with the numbers so you can't see it."

Then remove the second card and say: "So look carefully at these numbers first and see how they go." Give him thirty seconds for this, and then replace the third card with the fourth, marked 4 (opposite side of the second card), and say: "Now, do this carefully and get each number just right. What number goes in here?" (pointing to the first part in the upper left corner of the fourth card). Point to each in reading order as he gives the numbers. If he obviously guesses at the numbers, caution him after the second error with: "Be careful. Take your time for each one and get it right."

Use the "key" card in following the responses. Record the number of parts for which the wrong numbers are given (E) and the total time (T) for the nine parts.

Scoring. Passed if $5 \left(\frac{T}{3} + 10E \right) = 225$, or less.

5. **CROSSING OUT Q, R, S, T IN A PIED TEXT.** Place the sheet for this test before the child and say: **"Here is a sheet of paper with the alphabet on it all mixed up. I am going to see how fast you can cross out all the q's, r's, s's and t's. You cross out a q like this, an r like this, an s like this and a t like this** (show him in an illustration with the four letters at the top of the sheet by crossing out the q with a vertical stroke, the r with a horizontal one, the s with a diagonal one inclining to the right at the top, and the t with a diagonal one inclining to the left at the top). **Notice carefully how you are to cross out each letter, so that you won't have to look up so often to see."**

Then give him thirty seconds to memorize this. Then give him a pencil and say: **"Now, take one line at a time, always from left to right (passing your pencil over a line or two in this direction) and cross out all four letters as you go along. Don't go back to cross out any letters that you may have skipped. Begin."**

Watch him for the first line and call his attention to every error made, letters skipped, letters crossed out wrongly and wrong letters crossed out, and have him correct them. Give no further direction after this. Record the total time it takes him for the sheet (T) and the total number of errors (E), counting all three classes together, and including any he may have corrected by your direction in the first line. Errors corrected by himself are not counted.

A convenient way to determine the number of errors made is to count the number of letters he crosses out correctly while he is working, keeping a separate count of the wrong letters that he crosses out. Then subtract the number he crossed out correctly from fifty and add

to this remainder the number of wrong letters he crossed out.

Scoring. Passed if $\frac{T}{5} + 5E = 117$, or less.

6. **SIMPLE ARITHMETICAL PROBLEMS.** Show the child the blank for this test for a few seconds, and say: "Here are a number of simple problems in adding, subtracting, multiplying and dividing. I want to see how fast you can do them all and write the correct answer after each. In dividing you put down the fraction left over as well as the whole number. For instance, if you had $12 \div 5 =$, you would write $2\frac{4}{5}$." (Write this on a piece of paper so he can watch you as you give the illustration.)

Then give him the blank and say: "Now, begin at the top and take one after the other down. Be sure to get each one correct"

Record the total time (T) for the test. Use the card furnished with the testing materials giving the correct answers. Place the edge of this card alongside the column of problems, and count the total number of errors made (E).

Scoring. Passed if $\frac{T}{5} + 10E = 150$, or less.

7. **GIVING WORD OPPOSITES.** With the card for this test in your hand in inverted position, say: "I have twenty words here. I am going to see how fast you can begin with the top one and give me a word for each word you see here that means just the opposite. We will try it first with these five words on this card." Then give the five trial words, using them in any way necessary to make plain how it is to be done. He is simply to pronounce the opposites out loud, and not the words on the card.

Then place the list of twenty before him, face down, and say: "Now, we will try these. If you come to a word for which you cannot find an opposite, keep on trying until I say 'Next,' and then go on to the next word

at once. (Allow ten seconds for any such word.) **Ready.**" Then, after about a second, turn the card face up. Follow him with the duplicate list of words supplied for the examiner. Record the total time for the twenty words, and the total number of errors (E), counting as errors words given that are not opposites, and words skipped when told to skip by the examiner, or otherwise. Compute the average time for a word (T) by dividing the total time by twenty, counting the time for the words skipped.

Scoring. Passed if $30(T + E) = 235$, or less.

8. **IMMEDIATE RECALL OF UNFAMILIAR FORMS.** Place the sheet of blank circles for this test before the child, and with the ten cards for the test in your hand, say: **"Here are ten cards, each with a circle and four lines, like this** (showing a card in the middle of the pack for about a second, and in inverted position). **I will show you each card for ten seconds and you will then at once draw the four lines on one of these circles** (pointing to the sheet) **just as you saw them, and as fast as you can. Now, it will make it much easier to do this if you will remember that some of the four lines are inside the circle and some are outside** (showing these points on a card or two from the middle of the pack, as before); **that each line touches the circle exactly on a dot, or exactly half way between dots.**" (showing these points on a circle on the blank before him).

Then present the first card, face down, and say: **"Here is the first one. Ready,"** turning it face up about a second later. After ten seconds take away the card and say: **"Now, draw on this circle,"** pointing to the first blank circle.

Record the time taken to draw the four lines, but allow not over sixty seconds. Record the number of lines drawn wrongly plus those not drawn at all, and not counting errors due to roughness of drawing merely. Place the card face up in the same position as before while you

record the errors, so he may see the mistakes he made. Use the remaining cards in the same way. Compute the average time taken to draw the four lines of a card (T), and count the total number of errors for the ten cards, lines drawn wrongly plus lines omitted (E).

Scoring. Passed if $7T + 10E = 245$, or less.

AGE TWELVE YEARS.

1. SPELLING FAMILIAR WORDS BACKWARDS. Say: **"I am going to give you some words and see how fast you can spell them backwards."** Then give words from the following lists until five trials are secured from each of the two lists. Allow not more than sixty seconds for a word. If he fails, have him spell it forwards, and if he cannot readily spell it forwards, count it out as no trial, unless his ways of spelling it forwards and backwards agree and he has not made a shorter word out of it. In the latter case count it as correct. Record the time for each word and the number of trials on which he fails.

- | | | | |
|-------------|-------------|--------------|--------------|
| 1. Almost. | 11. Winter. | 1. Another. | 19. Morning. |
| 2. Pencil. | 12. Answer. | 2. Picture. | 11. Brought. |
| 3. Around. | 13. Bought. | 3. Outside. | 12. Because. |
| 4. Become. | 14. People. | 4. Instead. | 13. Against. |
| 5. Finger. | 15. Before. | 5. Already. | 14. Chicken. |
| 6. Ground. | 16. Minute. | 6. Country. | 15. Whistle. |
| 7. Behind. | 17. Coming. | 7. Counter. | 16. Janitor. |
| 8. Single. | 18. Sunday. | 8. Brother. | 17. Trouble. |
| 9. Income. | 19. Member. | 9. Tonight. | 18. Surface. |
| 10. Prince. | 20. Engine. | 10. However. | 20. Nothing. |

Compute the average time for a word (T) and count the total number of words on which he failed in the ten trials counted (E).

Scoring. Passed if $\frac{T}{5} + E = 5$, or less.

2. GIVING THE NUMBERS FOR THE DISSECTED PARTS OF A SIMPLE FORM. (1) There are two 6x8 inch cards, each with forms on both sides, for this test. Show the first card, marked 1, for the test and say: **"See these four**

lines crossing with the letters in the corners and parts. Here is 'a', 'b', 'c', down through on your left; 'd', 'e', 'f', down through the middle; and 'g', 'h', 'i', down through on your right" (pointing to the letters in order).

Then place the second card, marked 2, in front of the first and say: **"Now here are the parts, but the letters are not there. What letter goes in this one?"** (Point to the first part in the upper left corner of the card). If he does not understand at once what is meant, explain in any manner necessary, and have him in this way give the letters for the first five parts, taking them in reading order on the card, while he has both cards before him. Do not hurry him, and make sure that he understands.

Then place the third card, marked 3, (opposite side of the first card) in place of the first and say: **"Here is the same thing, only it has numbers instead of letters. I am going to see in a moment how fast you can give me the numbers for these parts (pointing again to the second card) after I take away this card with the numbers so you can't see it."**

Then remove the second card and say: **"So look carefully at these numbers first and see how they go."** Give him thirty seconds for this, and then replace the third card with the fourth, marked 4, (opposite side of the second card), and say: **"Now do this carefully and get each number just right. What number goes in here!"** (pointing to the first part in the upper left corner of the fourth card). Point to each in reading order as he gives the numbers. If he obviously guesses at the numbers, caution him after the second error with: **"Be careful. Take your time for each one and get it right."**

Use the "key" card in following the responses. Record the number of parts for which the wrong numbers are given (E) and the total time (T) for the nine parts.

Scoring. Passed if $5 \left(\frac{T}{3} + 10E \right) = 185$, or less.

3. CROSSING OUT Q, R, S, T IN A PIED TEXT. (2) Place the sheet for this test before the child and say: "Here is a sheet of paper with the alphabet on it all mixed up. I am going to see how fast you can cross out all the q's, r's, s's and t's. You cross out a q like this, an r like this, an s like this, and a t like this (showing him in an illustration with the four letters at the top of the sheet by crossing out the q with a vertical stroke, the r with a horizontal one, the s with a diagonal one inclining to the right at the top, and the t with a diagonal one inclining to the left at the top). Notice carefully how you are to cross out each letter, so you won't have to look up so often to see."

Give him thirty seconds to memorize this. Then give him a pencil and say: "Now take one line at a time, always from left to right (passing your pencil over a line or two in this direction) and cross out all four letters as you go along. Don't go back to cross out any letters that you may have skipped. Begin."

Watch him for the first line and call his attention to every error made, letters skipped, letters crossed out wrongly, wrong letters crossed out, and have him correct them. Give no further directions after this. Record the total time it takes him for the sheet (T) and the total number of errors (E), counting all three classes together, including any he may have corrected by your direction in the first line. Errors corrected by himself are not counted.

A convenient way to determine the number of errors made is to count the number of letters he crosses out correctly while he works, keeping a separate count of the wrong letters that he crosses out. Then subtract the number he crossed out correctly from fifty and add to this remainder the number of wrong letters he crossed out.

Scoring. Passed if $\frac{T}{5} + 5E = 110$, or less.

4. **SIMPLE ARITHMETICAL PROBLEMS.** Show the child the blank for this test for a few seconds and say: "Here are a number of simple problems in adding, subtracting, multiplying, and dividing. I want to see how fast you can do them all and write the correct answer after each. In dividing you put down the fraction left over as well as the whole number. For instance, if you had $12 \div 5 =$, you would write $2\frac{4}{5}$." Write this on a piece of paper so he can watch you as you give the illustration.)

Then give him the blank and say: "Now begin at the top and take one after the other down. Be sure to get each one correct."

Record the total time (T) for the test. Use the card furnished with the testing materials giving the correct answers. Place the edge of this card alongside the column of problems, and count the total number of mistakes made (E).

Scoring Passed if $\frac{T}{5} + 10E = 140$, or less.

5. **GIVING WORD OPPOSITES.** With the card for this test in your hand in inverted position, say: "I have twenty words here. I am going to see how fast you can begin with the top one and give me a word for each word you see here that means just the opposite. We will try it first with these five words on this card." Then give the five trial words, using them in any way necessary to make plain how it is to be done. He is simply to pronounce the opposites out loud, and not the words on the card.

Then place the list of twenty before him, face down, and say: "Now, we will try these. If you come to any word for which you cannot find an opposite, keep on trying until I say 'Next,' and then go on to the next word at once. (Allow ten seconds for any such word). Ready." Then, after about a second, turn the card face up. Follow him with the duplicate list of words supplied for the examiner. Record the total time for the twenty

words, and the total number of errors (E), counting as errors words given that are not opposites, and words skipped when told to skip by the examiner, or otherwise. Compute the average time for a word (T) by dividing the total time by twenty, counting the time for the words skipped.

Scoring. Passed if $30(T + E) = 195$, or less.

6. IMMEDIATE RECALL OF UNFAMILIAR FORMS. Place the sheet of blank circles for this test before the child, and with the ten cards for the test in your hand, say: "Here are ten cards, each with a circle and four lines, like this (showing a card in the middle of the pack for about a second, and in inverted position.). I will show you each card for ten seconds and you will then at once draw the four lines on one of these circles (pointing to the sheet) just as you saw them, and as fast as you can. Now, it will make it much easier to do this if you will remember that some of the four lines are inside the circle and some are outside (showing these points on a card or two from the middle of the pack, as before); that each line touches the circle exactly on a dot, or exactly half way between dots" (showing these points on a circle on the blank before him).

Then present the first card, face down, and say: "Here is the first one. Ready," turning it face up about a second later. After ten seconds, take away the card, and say: "Now, draw on this circle," pointing to the first blank circle.

Record the time taken to draw the four lines, but allow not over sixty seconds. Record the number of lines drawn wrongly plus those not drawn at all, and not counting errors due to roughness of drawing merely. Place the card face up in the same position as before while you record the errors, so he may see the mistakes he made. Use the remaining cards in the same way. Compute the average time taken to draw the four lines of a card (T), and count the total number of errors for

the ten cards, lines drawn wrongly plus lines omitted (E).

Scoring. Passed if $7T + 10E = 205$, or less.

7. FOLLOWING DIRECTIONS IN A CONFUSING TEXT. Give the child the printed sheet for this test, and say: "Read this page, paying no attention to the sense of what you read, but make the marks and fill in the blanks according to the directions that you read, as fast as you can. Read the first part out loud and I will show you what I mean." Then let him read to the first comma, and say: "Stop. Now do that first." Give him plenty of time and necessary explanations until he does this correctly. Then say: "Now, read on," and let him read to "Then if Christmas—," and call "Stop. Now, do that," and proceed as before. Then, when he has placed this comma correctly, say: Now, read the rest to yourself, and be sure to notice exactly what it tells you to do, and then do that. The point is not to let it get you mixed up."

Record the total time (T) it takes to finish the sheet from the point where he begins to read to himself, and the total number of errors (E) he makes. Count errors he makes for the first lines that he read out loud, if any. Everything not exactly according to directions, or omitted or added, is counted an error. Nothing is counted an error unless it positively contradicts directions.

Scoring. Passed if $2 \left(\frac{T}{6} + 5E \right) = 165$, or less.

8. LOCATING SECTIONS OF A DIVIDED SQUARE FROM DESCRIPTION. Place the sheet with the divided square for this test before the child and say: "This square, you notice, is divided into upper and lower halves by this heavy line, and into right and left halves by this heavy line (pointing out the lines). That divides the whole into four quarters; upper left quarter here, lower left quarter here, and so on. Each of these quarters is again divided into halves and quarters by these lighter lines (pointing out the lines). For instance, this is the upper left quarter of the lower right quarter. Is that right? (Repeat if he has

not followed you). And these two here together are the right half of the lower left quarter. Is that right? (Speak slowly and give plenty of time for him to follow you.)

"Now, I am going to see how fast you can cross out the dot that is in the middle of each of the ten sections described on this card (showing the card for a second or two). We will take the three on this other card first to show you (placing this second card in front of the sheet with the divided square). Now, the easiest way to do this is to take the several parts of each line backwards, last part first. For instance, this first one says: (Read the first one). But you take the last part first, and find first the lower left quarter (pointing to this part of the line) of the whole square. Where is the lower left quarter of the whole square? (Show him if he fails). Now, notice that you want the upper right quarter of this (pointing to this part of the line on the card). Now, which dot do you cross out?"

Give any further explanation necessary to make sure that he understands the three trials on this card, by repeating directions and by showing him which parts are wanted.

Then replace the trial card with the other having the list of ten, and say: "Now, see how fast you can do these ten, one after the other." Each time he crosses out a dot call the next number for him, so he will not lose his place on the card.

Follow the errors with the "Key" card, record the number that he gets wrong (E) and the total time for the ten trials (T). Errors he corrects himself are not counted.

Scoring. Passed if $1.3(\frac{T}{5} + 10E) = 133$, or less.

AGE THIRTEEN TO FIFTEEN YEARS.

1. SIMPLE ARITHMETICAL PROBLEMS. (3) Show the child the blank for this test for a few seconds and say:

"Here are a number of simple problems in adding, subtracting, multiplying and dividing. I want to see how fast you can do them all and write the correct answer after each. In dividing, you put down the fraction left over as well as the whole number. For instance, if you had $12 \div 5 =$ you would write $2\frac{2}{5}$." (Write this on a piece of paper so he can watch you as you give the illustration.)

Then give him the blank and say: "Now, begin at the top and take one after the other down. Be sure to get each one correct."

Record the total time (T) for the test. Use the card furnished with the testing materials giving the correct answers. Place the edge of this card alongside the column of problems, and count the total number of mistakes made (E).

Scoring. Scores required for passing are as follows:

| | | |
|---------------|-----------------------------|----------|
| Age thirteen, | $\frac{T}{5} + 10E = 125$, | or less. |
| " fourteen | " = 112 | " " |
| " fifteen | " = 100 | " " |

2. GIVING WORD OPPOSITES. (4) With the card for this test in your hand in inverted position, say: "I have twenty words here. I am going to see how fast you can begin with the top one and give me a word for each word you see here that means just the opposite. We will try it first with these five words on this card." Then give him the five trial words, using them in any way necessary to make plain how it is to be done. He is simply to pronounce the opposites out loud, and not the words on the card.

Then place the list of twenty before him, face down, and say: "Now, we will try these. If you come to any word for which you cannot find an opposite, keep on trying until I say 'Next,' and then go on to the next word at once. (Allow ten seconds for any such word). Ready." Then, after about a second, turn the card face

up. Follow him with the duplicate list of words supplied for the examiner. Record the total time for the twenty words, and the total number of errors (E), counting as errors words that are not opposites, and words skipped when told to skip by the examiner, or otherwise. Compute the average time for a word (T) by dividing the total time by twenty, counting the time for the words skipped.

Scoring. Scores required for passing are as follows:

Age thirteen, $30(T+E)=160$, or less.

“ fourteen, “ =125, “ “

“ fifteen, “ =100, “ “

3. IMMEDIATE RECALL OF UNFAMILIAR FORMS. (5)

Place the sheet of blank circles for this test before the child, and with the ten cards for the test in your hand, say: **“Here are ten cards, each with a circle and four lines, like this** (showing a card in the middle of the pack, and in inverted position). **I will show you each card for ten seconds and you will then at once draw the four lines on one of these circles (pointing to the sheet) just as you saw them, and as fast as you can. Now, it will make it much easier to do this if you will remember that some of the four lines are inside the circle and some are outside** (showing these points on a card or two from the middle of the pack, as before); **that each line touches the circle exactly on a dot, or exactly half way between dots”** (showing these points on a circle on the blank before him).

Then present the first card, face down, and say: **“Here is the first one,”** turning it face up about a second later. After ten seconds, take away the card, and say: **“Now, draw on this circle,”** pointing to the first blank circle.

Record the time taken to draw the four lines, but allow not over sixty seconds. Record the number of lines drawn wrongly plus those not drawn at all, and not counting errors due to roughness of drawing merely. Place the card face up in the same position as before

while you record the errors, so he may see the mistakes he made. Use the remaining cards in the same way. Compute the average time taken to draw the four lines of a card (T), and count the total number of errors for the ten cards, lines drawn wrongly plus lines omitted (E).

Scoring. Scores required for passing are as follows:

| | | |
|---------------|----------------|----------|
| Age thirteen, | $7T+10E=165$, | or less. |
| " fourteen | " =130 | " " |
| " fifteen | " =100 | " " |

4. FOLLOWING DIRECTIONS IN CONFUSING TEXT. (6)
Give the child the printed sheet for this test, and say: **"Read this page, paying no attention to the sense of what you read, but make the marks and fill in the blanks according to the directions that you read, as fast as you can. Read the first part out loud and I will show you what I mean."** Then let him read to the first comma, and say: **"Stop. Now, do that first."** Give him plenty of time and necessary explanations until he does this correctly. Then say: **"Now, read on,"** and let him read to **"Then if Christmas—,"** and call **"Stop. Now, do that,"** and proceed as before. Then, when he has placed the comma correctly, say: **"Now, read the rest to yourself, and be sure to notice exactly what it tells you to do, and then do that. The point is not to let it get you mixed up."**

Record the time (T) it takes to finish the sheet from the point where he begins to read to himself, and the total number of errors (E) he makes. Count errors he makes for the first lines that he read out loud, if any. Everything not exactly according to directions, or omitted or added, is counted an error. Nothing is counted an error unless it positively contradicts directions.

Scoring. Scores required for passing are as follows:

| | | |
|---------------|-----------------------------|---------|
| Age thirteen, | $2(\frac{T}{6} + 5E)=140$, | or less |
| " fourteen | " =120 | " " |
| " fifteen | " =100 | " " |

5. LOCATING SECTIONS OF A SQUARE FROM DESCRIPTION.

(7). Place the sheet with the divided square for this test before the child and say: "This square, you notice, is divided into upper and lower halves by this heavy line, and into right and left halves by this heavy line (pointing out the lines). That divides the whole into four quarters; upper left quarter here, lower right quarter here, and so on. Each of these quarters is again divided into halves and quarters by these lighter lines (pointing out the lines). For instance, this is the upper left quarter of the lower right quarter. Is that right? (Repeat if he has not followed you). And these two here together are the right half of the lower left quarter. Is that right?" (Speak slowly and give plenty of time for him to follow you).

"Now, I am going to see how fast you can cross out the dot that is in the middle of each of the ten sections described on this card (showing the card for a second or two). We will take the three on this other card first to show you (placing this second card in front of the sheet with the divided square). Now, the easiest way to do this is to take the several parts of each line backwards, last part first. For instance, this first one says: (Read the first one). But you take the last part first, and find first the lower left quarter (pointing to this part of the line) of the whole square. Where is the lower left quarter of the whole square? (Show him if he fails). Now, notice that you want the upper right quarter of this (pointing to this part of the line on the card). Now, which dot do you cross out?"

Give any further explanation necessary to make sure that he understands the three trials on this card, by repeating directions and by showing him which parts are wanted.

Then replace the trial card with the other having the list of ten, and say: "Now, see how fast you can do these ten, one after the other." Each time he crosses out a dot,

call the next number for him, so he will not lose his place on the card.

Follow the errors with the "key" card, record the number that he gets wrong (E) and the total time for the ten trials (T). Errors he corrects himself are not counted.

Scoring. Scores required for passing are as follows:

Age thirteen, $1.3(\frac{T}{5} + 10E) = 118$, or less.

" fourteen " = 108 " "

" fifteen " = 100 " "

6 DRAWING TRIANGLES ON A SQUARE ACCORDING TO DIRECTIONS. (8) Place a sheet of blank squares for this test before the child and say: "On each of the squares you have there you are to draw a triangle according to the description given on one of these cards (holding the pack of cards in your hand). I will draw the triangle for this card first to show you."

Then on a blank square of another sheet draw the triangle for "Trial card E," reading the description aloud for each part, having placed the card so he can read it at the same time. Mark each part on the square as you proceed, a check mark where the corner of the triangle is to be, a short line through the point on the square where the side of the triangle is to go through, and a short line outside the square touching its corner at the line's middle. As you read each part of the card, explain as follows: "Now, we will put a check mark like this, here, so we will remember that a corner of the triangle is to go there," for the first part, and, "We will put a short line through here to show that a side of the triangle is to go through here," for the second part, and, "We will mark this with a line like this to show that a second side of the triangle is to run by and touch this corner of the square," for the third part. "Now, do you see how the triangle will be? It will be like this." Then draw the triangle, making the sides longer than necessary, and have them cross at the corners of the triangle.

Then repeat in further explanation: "Now, one of the corners is at the middle of the upper side of the square, as the card says. See? (pointing at the card). And one of the sides of the triangle passes through the lower right corner of the square, as the card says; and a second side touches the lower left corner of the square, as the card says," pointing to the description on the card each time.

Then give "Trial card S" and say: "Now, you take this one for trial first, and see if you can draw the triangle as the card says. It won't count." Help him, if necessary, to get it correct, and be sure to have him place the preliminary check mark and short lines for the three parts, as was done in the illustration.

Then give him the first card in the series of five and say: "Now, see how fast you can do the rest."

Record the time and the number of errors for each card, an error being a side or a corner drawn wrongly. The terms "touching a corner" and "passing through" a corner or side are to be taken only in the way as used in the illustration. Compute the average time for a card (T), and the total number of errors (E) for the five cards.

Scoring. Scores required for passing are as follows:

| | | | | |
|---------------|---------------|---------|---|---|
| Age thirteen, | $T+15E=113$, | or less | | |
| " fourteen | " | $=106$ | " | " |
| " fifteen | " | $=100$ | " | " |

7. DRAWING UPRIGHT FORMS IN INVERTED POSITIONS. Give the child a sheet with the large blank squares for this test, and, with the cards for the test in your hand, say: "I have some cards here, each having a square with lines and dots inside, something like this one (placing the "Trial card" right side up immediately in front of the sheet with the blank squares). I am going to see how fast you can draw the lines in one of the squares you have there, not the way they are on the card, but the way they would be if the card were turned upside down. We will try it with this one first for two minutes (point-

ing to the trial card) and you may turn this one upside down as much as you want to, to see how the line will come. (Explain further if necessary). The other cards you will always leave right side up."

Then give him the two minutes with the trial card, using the first blank square, and telling him when the first minute is up. Immediately after the two minutes give the first of the series of five cards. Record the time for each card, and the number of lines drawn wrongly. A line with either one or both ends wrong counts for one error. In recording the errors for each card, turn the card upside down and check off the lines correctly drawn, letting him see his errors each time. Encourage by noting the great difficulty of the task set, and that no high degree of accuracy is expected. Compute the average time (T) for a card, and the total number of errors (E) for the five cards.

Scoring. Scores required for passing are as follows:

Age thirteen, $\frac{T}{2} + 10E = 190$, or less.

" fourteen " = 145 " "

" fifteen " = 100 " "

8. MAKING LOGICAL INFERENCES. (10) Give the child a pencil and some blank paper, and with the cards for this test in your hand, say: "On each of these cards are two statements from which one, and only one, correct conclusion can be drawn. There are always four conclusions given on each card, but, of course, only one of them is correct. I am going to see how quickly you can tell me in each case which is the correct one. I will show you first with this card."

Then place the "Trial card" before him, read it to him slowly, and then say: "Now, this does not mean anything until you let the letters stand for something. Suppose we let them stand for circles; we can then draw the circles and see how it will come out." Then, turning to the trial card, continue: "'If no A is B' means that no part of the A circle is in the B circle, like this

(drawing two one-inch circles about an inch apart, and marking them A and B on their circumferences). Now **"All C is A" means that all the C circle is inside the A circle, like this**" (drawing a smaller circle entirely inside the A circle, and marking it C). Then read the four conclusions on the card about C and B, and point out why the first three are wrong, and the fourth correct.

Then say: **"Now, we will take these other cards one at a time, and you may draw all the circles you want to, or as few as you need to, to figure out in each case as fast as you can which one of the conclusions is the correct one."** Then give him the cards in order. Correct the first three errors made, but no more, as it might discourage him. Encourage.

Record the time for each card, and an error for each wrong conclusion given, counting his final decision only on any card, if he changes his first one. Compute the average time (T) for a card and the total number of cards for which he chooses the wrong conclusion (E).

Scoring. Scores required for passing are as follows:

| | | |
|---------------|---------------|----------|
| Age thirteen, | $T+10E=125$, | or less. |
| " fourteen | " =112 | " " |
| " fifteen | " =100 | " " |

CHAPTER V

COMMENTS ON THE INDIVIDUAL TESTS

In the preceding chapter every effort has been made to present the directions for giving the tests and for scoring in a way that would be most convenient for use in the conduct of an examination. This has been deemed important. The attention of the examiner should be left as free as possible for the control of the subject under examination and for the management of details that cannot be made automatic. For this reason only the essentials in the directions are given there. In the present chapter are collected various comments about the individual tests that are of interest chiefly to the student of mental tests. Occasional remarks are included, however, that will be found of value to the examiner as such. Half or more of the remarks made here about the tests in the original 1908 Binet-Simon scale, and which are retained in the present system, are condensed from statements made by the authors of that scale. They are included here without further references or quotations. No attempt is made here to summarize all the views and comments of the various writers on these tests. Such a procedure would take us quite beyond permissible limits.

The tests in the lowest age-groups of the scale, all below age-group III, are only roughly standardized, as has already been noted, and are not to be compared in this respect with the others. They were originally arranged in these age-groups chiefly on the basis of a very careful study of observations of other writers on the mental development of children during this age period. These observations make up very largely in detail and trustworthiness what they lack

in number.¹ But there are complicating factors. First, the children figuring in these observations were very probably on the whole above average in mental development. Second, most of the observations made on mental development during this period are of activities that cannot be reproduced in the child at will on the part of an examiner. They do not furnish a basis for a test. Third, there are many degrees of readiness with which children of these ages will respond to given stimuli and situations. A given response, made spontaneously and observed only occasionally at a given age, is not likely to be aroused at all at the same age under test conditions. The manner of giving the tests was worked out first in trying them out on feeble-minded with mental ages chiefly below four. After using them on normal children a number of changes were made in the procedure, and a group for the age of eighteen months was added. They are offered here now, as they were in my previous revision of the Binet-Simon scale, not as closely comparable in accuracy and reliability with the tests of the other parts of the scale, but simply as furnishing a better means than we have heretofore had for judging the mentalities of children of these ages.

Three Months, 1. Carrying Hand or Object to Mouth.

In the earliest random movements of the arm the hands frequently come in contact with the mouth by chance. From the repetition of this develops the ability to carry the hand to the mouth at will. This ability rests on a tactual motor association, and is acquired earlier than the ability to reach for seen objects.

1. The observations referred to here will be found chiefly in the following: Preyer, W. *The Mind of the Child*, Part 1. *The Senses and the Will*. Part II. *The Development of the Intellect*. *Observations Concerning the Mental Development of the Human Being in the First Three Years of Life*. Trans. by H. W. Brown. New York, 1909.

Moore, Mrs. K. C. *The Mental Development of a Child*. Psychological Review, Monograph Supplements, 1896.

Shinn, M. W. *Notes on the Development of a Child*. Part I. 1893-99. Part II. 1907. University of California Publications in Education, Vols. I. and IV.

Major, D. R. *First Steps in Mental Growth. A Series of Studies in the Psychology of Infancy*. New York, 1906.

Dearborn, G. V. N. *Moto-Sensory Development. Observations on the First Three Years of a Child*. Baltimore, 1910.

Three Months, 2. Reactions to Sudden Sounds. Reactions to sudden sounds appear during the first week after birth. At this time it may be a general "starting" over the whole body, or only a slight quiver of the eyelids. Its character varies much during the first three months, both from one child to another, and with the same child at different times. For a while reactions are frequently entirely absent. They increase much in frequency and intensity, and by the end of the third month the child reacts almost invariably with a wink or a "start" to most sudden sounds. Later this reaction disappears again, first the general "starting," then the wink, so that in older children and in adults only very loud and unusual sudden noises cause this reflex action. The important characteristic of the reaction at the age of three months is its intensity and the readiness with which it occurs.

Three Months, 3. Binocular Co-ordination. The eyes follow a moving light in a co-ordinated manner much of the time soon after birth. Towards the end of the second month inco-ordination is rare, and during the third month it is seldom observed in the ordinary range of eye movements. The eyes of the one or two months' old child, however, do not follow a light as far as later, and inco-ordination appears readily for the extreme positions. Also, the younger child turns the head with the eyes more. Turning the eyes independently in following moving objects usually occurs first by about the second month.

Three Months, 4. Turning Eyes to Object in Marginal Field of Vision. Following a moving light placed directly before the eyes and then moved away occurs more readily than turning towards a light brought into the field of vision. The first step in visual development consists of staring at an object on which the eyes fall by chance. This occurs occasionally at once after birth. Turning the head and eyes toward an object in the marginal field of vision is the next step. This occurs sometimes as early as the first week and develops rather gradually as a reflex, which

later is readily inhibited. At the end of three months this reflex is well developed and occurs readily.

Three Months, 5. Winking at an Object Threatening the Eyes. A sudden approach of an object to within a few inches of the child's face rarely causes a wink during the first six weeks. This reflex appears first towards the end of the second month, and increases rather rapidly in frequency and readiness. During the third month it becomes almost invariable and remains so throughout life. It is essential that the object used be large. The hand alone, for example, may not cause the wink, when a larger object does so readily.

Six Months, 1. Balancing Head and Sitting. Momentary balancing of the head occurs during the third month. Ability to hold up the head indefinitely when the child is held in the vertical position develops rapidly, and is usually quite well established before the end of the fifth month. Ability to sit up when supported in the back appears slightly later than the ability to balance the head. Children six months old sit up momentarily unsupported in the great majority of cases, and can do so indefinitely before the end of the tenth month.

Six Months, 2. Turning Head Towards Source of a Sound. During the third month the child begins to turn the head on hearing a sound. This turning is at first usually not accurate, but increases in frequency and readiness and takes on the character of a real searching, as if the child were trying to see the object making the sound. By the sixth month the child turns the head readily and accurately towards the source of a sound.

Six Months, 3. Opposing Thumb in Grasping. The child readily clasps objects touching its palm soon after birth. This reflex develops rapidly to a maximum intensity and later decreases again. Co-operation of the thumb, however, is absent in this early clasping. The first evidence of opposition of the thumb seems to appear during the fourth month. This may be noted in the slight resistance met when

lifting the thumb during the reflex clasp. This resistance increases, and by the age of six months co-operation of the thumb with the fingers is usually well developed.

Six Months, 4. Prolonged Holding of Object Placed in Hand. As a reflex the clasping of an object usually lasts only a few seconds, when the object is left resting passively in the child's hand. By the end of the third month the child begins to hold on to objects for longer periods. At the age of six months there is unquestionable evidence of more than the original reflex clasping. It has been interpreted as conscious voluntary holding of objects.

Six Months, 5. Reaching for Seen Objects. The sight of attractive objects begins to arouse random arm movements by the end of the fourth month. From this time the child learns rather rapidly to guide the hand successfully toward the seen object. By the beginning of the sixth month he seizes readily objects reached for.

Twelve Months, 1. Sitting and Standing. A child one year old nearly always can sit up for an indefinite length of time without support. He learns to stand unsupported for a few seconds slightly later, but the majority do so when one year old.

Twelve Months, 2. Speech. Very frequently vocal responses cannot be obtained from a child even though he is accustomed to give them spontaneously at other times. As often as not the scoring in this test has to be determined by the evidence obtained from the mother or nurse alone. By the end of the first year the child's speech is at the height of the babbling stage. The earlier individual sounds are largely replaced by short series of syllables. About the same time the first attempts to imitate sounds appear. It also usually understands a few words, has formed the associations between a few names and objects. But the last is difficult to determine in any test.

Twelve Months, 3. Imitation of Movements. Satisfactory responses in this test depend much on the momentary inclination and disposition of the child. Many children

who imitate readily cannot be made to do so in a test. The child begins to imitate some things before the end of the first year. The maximum tendency to imitate develops considerably later.

Twelve Months, 4. Marking With a Pencil. A child will often imitate the movement made in marking without evidence of a "purpose" to make marks, or of understanding that the pencil makes the marks. The general nature of his reactions must determine whether it is imitation of a movement merely, or an effort to make marks. The response is scored passed only if the latter is the case. This stage in drawing or writing begins about the end of the first year. Attempts to copy forms or to draw them spontaneously appear about a year later.

Twelve Months, 5. Recognition of Objects. The child probably recognizes a number of things before this age, but unequivocal expressions of recognition do not appear much before the end of the first year, and develops rather rapidly from this time on. By the time he names any object the process is already well advanced. It is a significant point in mental development, but is difficult to determine in its early stages by any tests.

Eighteen Months, 2. Feeding With a Spoon or Fork. Inasmuch as it is usually inconvenient to try "a" or "b" of this test, the information obtained from the parent or nurse may be taken instead, but special caution is necessary here against accepting affirmative statements merely, from a parent.

Eighteen Months, 3. Speech. Parents frequently wrongly interpret various vocalizations of a child as distinct words, or efforts to use such words, as well as accept evidence that a child understands a question, when such evidence is not at all conclusive. In "c" of this test the parent should be required to give reasonable proof of affirmative statements.

Eighteen Months, 4. Spitting Out Solids. The test fails more or less frequently with bread and vinegar, but it

is not practical to try a variety of different substances. Failure of the test consists in no reaction at all made by the child, or swallowing the bread. Neither can be interpreted either as a pass or a failure for the child.

Eighteen Months, 5. Recognition of Objects in Pictures. The recognition of objects in pictures follows closely the recognition of the objects themselves in mental development. In both, however, the signs of recognition in the child's reactions are somewhat difficult to interpret. Usually the parent is incapable of doing so correctly. It requires some considerable experience on the part of the examiner.

II 1. *Pointing Out Objects in Pictures.* Frequent instances of feeble-minded children failing to pass the picture test that calls for enumeration of objects in the picture when they readily pointed out objects in the picture in response to the command "Show me the —," suggested this test for this age-group. From the standpoint of discriminative capacity and applicability it seems to be a very good test. There is a considerable tendency to point at random at the card to every question. Such responses, when the child is evidently merely not attending, are not counted. The object is to determine whether he can understand and point out correctly when his attention is good.

II 2. *Imitation of Simple Movements.* This test and its location in the scale was taken from the Binet-Simon 1905 series. Urging in the test is often necessary, because of timidity or disinclination. The trials should be repeated if responses are not obtained at once, in varied forms if necessary, until the cause of the failure to respond correctly becomes evident.

II 3. *Obeying Simple Commands.* This test is a modification of one in the Binet-Simon 1905 series. As in test II 2, urging is often necessary. If the mother's statements are accepted as evidence, instances in which the child actually carries out a command alone should be considered, ruling out a mere affirmation that the child is capable or that he attempts to do things on command.

II 4. *Copying a Circle*. Like test I 4, marking with a pencil, this one was suggested by the tests on copying a square, and a diamond, used higher in the scale. The circle is psychologically the simplest of all geometrical forms, and is the first the child learns to make.

II 5. *Removal of Wrapping From Food before Eating*. Used in the Binet-Simon 1905 series, with slightly different procedure.

III 1. *Enumeration of Objects in a Picture*. Original Binet-Simon test from the 1908 scale. The authors used colored pictures. Terman's standardization of this test using pictures in black and white showed that the colors are not essential. The authors' pictures were somewhat unsatisfactory for the test in this age-group, as they did not contain sufficient details familiar to three-year-old children to call forth enumeration. The same is true in a lesser degree of the pictures used by Terman. Both Binet-Simon and Terman used these pictures in two other higher age tests, calling for description and interpretation, respectively, and both the original pictures and Terman's substitutes are well adapted for testing the capacity to interpret. In the present scale the pictures used were especially drawn to meet only the requirements for the test on the ability to enumerate and the ability to describe.¹ No test on ability to interpret is used in the scale.

The child's reactions to pictures develop through a number of distinct stages. For several of these simple and brief tests are sufficient to determine whether he has reached a stage in question. These are as follows: (a) Recognition of objects in pictures. (b) Name associated with the object in a picture and ability to point out the object in the picture when named to him. (c) Ability to give the names of objects in a picture; enumeration. (d) Ability to see simple relations and to in part describe the picture. (e)

1. The writer is indebted to Miss Margaret Wittman, teacher in the Minnesota School for Feeble-Minded, for the original drawings of these pictures, made with the aid of a general description of the subjects, and the details that were to go into each.

Ability to interpret the meaning of a picture. The object of the present test is to determine whether the child is able to name things seen in a picture.

III 2. *Pointing Out Parts of Body.* Original Binet-Simon test from 1908 scale, with the last part, "Show me your hair," added. The test is largely one of language comprehension in one of its early stages. The child first understands only our gestures. Next he learns to repeat roughly a few sounds and words spoken to him, and soon after learns the meaning of a few. Lastly, he learns to use words as a means of communication. This test involves next to the last of these stages, in connection with a discrimination of different parts of the body.

III 3. *Giving the Family Name.* Original Binet-Simon test from the 1908 scale. Nearly every child of three knows his first name. If he gives this, it may be taken as good evidence that failure to give his last name is not due to timidity or disinclination. Names difficult to pronounce do not usually disincline the child to make an effort. He will give some recognizable substitute.

III 4. *Repetition of a Sentence of Six Syllables.* Repeating a sentence of six syllables was a Binet-Simon 1908 test, but the authors suggested the use of a number of different sentences, without giving a definite method of procedure. The present writer substituted the first two sentences used here in his 1912 revision, keeping one of the originals. In the present revision this last one is dropped for one used by Terman. Experience with this kind of test has shown that the exact nature and content of the sentence used is, within limits, about as important as its length. This is especially true for young children.

Imperfect pronunciation characteristic of this age sometimes make it difficult to judge whether the child's repetition is correct word for word or not. But if he uses the correct number of words with only one or two unintelligible, the repetition may be regarded as satisfactory. Substitutions of other words of his own for those read to him belong to a

much later stage of development. A frequent form of failure consists of repeating only a few of the important words of the sentence, such as "Dog, cat," or "Hen on nest."

III 5. *Naming of Familiar Objects.* This was given in age-group IV in the Binet-Simon 1908 scale, using only a key, closed pen-knife, and a sou, all of which had to be named correctly. The present writer added, "Watch, ball and pencil," and required four out of six to be named correctly in his 1912 revision. Terman uses this list, omitting the ball and requiring three of the five to be named correctly. He places it in age-group III.

"Money" for penny, and "Clock" for the watch are accepted as satisfactory. The object of this test is to find whether he can name these particular things, which is different from naming some of the things seen in a picture.

III 6. *Repeating Two Numerals.* Original Binet-Simon 1908 test, in the same form as given here. Numerals are more difficult to repeat than are words making a sentence, just as words are more difficult to repeat when they make no sentence. Hence, a child that repeats a sentence of six syllables may readily fail in repeating only three numerals. A frequent failure consists in repeating only the last of the two numerals, there being a general tendency on the part of children to repeat only the last word or part in any test similar to this.

III 7. *Naming Pictures From Memory.* A new test. This is the simplest form of a memory test involving active recall. The three-year-old child's ability to pass it depends, first, on the fact that the pictures have been carefully chosen so as to include only objects most likely to be familiar to the child; second, on the compulsory attention in making the child name them over twice; third, on the immediacy of the recall; and, fourth, on the fact that two of the three pictures remain before him, and help to suggest the missing one. At this age the child has a very limited ability to control his mental imagery in the manner required in active, voluntary recall, such as the adult knows it. Evidence of

this appears incidentally in the test in the fact that very frequently in the second or third trial the child will name a picture shown in a preceding trial for the one taken away.

III 8. *Tracing a Square*. A new test. Marking with a pencil (12 months 4), copying a circle (II 4), tracing a square (III 8), tracing an irregular form (IV 5), copying a square (V 2), and copying a diamond (VII 8) are similar tests, viewed objectively. But the increasing difficulty they present, as shown by the different ages at which they are placed, undoubtedly means that they involve entirely different mental processes for the child.

The illustration given the child by the examiner is important, and special care should be taken to give it exactly as stated. The child probably in some measure imitates the rate, and the more "deliberation" shown by the examiner the more will be invoked in the child. The majority of children of this age do not understand the verbal directions of this test at all if unaccompanied by the illustration.

IV 1. *Giving Sex*. Original Binet-Simon 1908 test. Terman uses it in age-group III. The difference in the form of the question for boys and girls is necessary because of the tendency of children to repeat the last part of any remark made to them in all such questions.

IV 2. *Repetition of Three Numerals*. Original Binet-Simon 1908 test, which does not give the numerals to be used. Terman uses it in age-group III as an alternative test, and requires the repetition to be in correct order as well as giving the correct numerals. In the repetition of numerals, especially for longer series used with older children, the response is often correct except that the order is changed. It is difficult to say what this change in order is due to. It is not necessarily on account of lack of memory.

IV 3. *Comparison of Two Lines*. Original Binet-Simon 1908 test. The authors suggest only one trial, and their procedure is somewhat different. The procedure given here is the same as in my 1912 revision, which is slightly modified by Terman.

Failure in this test is often due to inability to understand the task rather than to inability to see the difference between the two lines, or to make the comparison. The form of the question used here is regarded as better than the question, "Which is the longer of these two lines?" The four-year-old child often does not understand the word "lines." A frequent form of failure consists of pointing indiscriminately at any part of the card. In such cases it is often difficult to determine whether the failure is due to the carelessness in pointing out, or to inability. Further trials, with variations in the procedure, must decide. Sometimes the command, "Put your finger on the big one," is sufficient in such cases.

IV 4. *Discrimination of Forms.* A new test, used first in my 1912 revision, and more thoroughly standardized by Terman in 1916.

Failures are sometimes due to inability to understand the task, but more frequently to inability to discriminate. Occasionally a child will persist in pointing at random at any form at once without effort to find the right one. In that case the examiner must use his judgment in counting or not counting such choices as errors. Such instances do not occur often.

IV 5. *Tracing Irregular Form.* A new test. The form used in this test was constructed with the idea of getting one that would combine movements of different lengths in all directions with changes in direction at different angles. The passing score is rather low. The test could probably be used in higher age-groups with the requirement of a better score. Care should be taken to do the tracing in the illustration given the child at the right rate, as this will influence the rate at which the child will try to do it. Many four-year-old children do not understand the verbal directions at all in this test, when given without the illustration.

IV 6. *Recognition of Forms*. A new test. The forms used here were copied from a study made by Simpson.¹ The task set the child in the present test is, however, entirely different. On first consideration the test is likely to seem entirely too difficult for four-year-old children. But the processes involved are those of recognition, which are passive, do not require voluntary control, while those of recall are active. Also, the cards are all quite different from each other, and not too numerous, militating against easy confusion.

IV 7. *Comprehension*. The test as it stands is taken from Terman. The first two questions used were given in the Binet-Simon 1905 series, to which Terman added the third. He notes that: "The purpose of these questions is to ascertain whether the child can comprehend the situations suggested and give a reasonably pertinent reply. The first requirement, of course, is to understand the language; the second is to tell how the situation suggested should be met."

IV 8. *Naming Pictures From Memory*. A new test. Although identical with III 7, excepting that four instead of three pictures are used in each trial, this test is considerably more difficult for children, and would be entirely too difficult for four-year-old and probably even for five-year-old children, if only one more picture were added. The reason for this has not appeared in any analysis so far made. The pictures used have been selected with considerable care. It is necessary to get a series of objects familiar to children of this age, and which they can readily name. The list from which one can choose for this age is not very large.

V 1. *Counting Four Petnies*. An original Binet-Simon 1908 test, used here in the same form. Terman places it in age-group IV.

The child learns to count before he can apply the counting process to objects, that is, before he can count correctly a group of objects. The former soon becomes quite mechani-

1. Simpson, B. R. *Correlation of Mental Abilities*. Teachers College, Columbia University Contributions to Education, No. 53. 1912.

cal, but the latter requires some control of this mechanical process. Counting a group of objects, again, is easier than counting a series of successive stimuli, whether they be objects seen or a series of sounds. Finally, the greatest degree of control of the counting process is required in counting a series that is irregular, such as a series of sounds coming at irregular intervals.

V 2. *Copying a Square*. A Binet-Simon 1908 test. The authors deem it important that the child draw with a pen instead of with a pencil. No statistical study has been made comparing the two methods. From the writer's general experience it seems that it does not matter essentially whether pen or pencil is used. However, the original procedure is adhered to here. The authors do not indicate the number of trials to be given or the number of successful trials to be required for passing. Terman substitutes a pencil for the pen, and places the test in age-group IV.

V 3. *Comparison of Weights*. An original Binet-Simon test, but the procedure here is considerably modified. The authors used two pairs of weights of 3 and 12, and 6 and 15 grams, respectively. A pair was placed before the child and he was asked to tell which was the heavier, without the lifting being illustrated. The two weights used in the present test are 6 and 24 grams. Terman uses weights of 3 and 15 grams, with a procedure essentially the same as given in the present test, except that he requires two out of three trials for a pass. It appears that the weights may vary considerably both in relative and in absolute weight without affecting the result materially. As in some other tests, failure in this one is often due to inability to understand the task rather than to inability to discriminate the weights. The procedure given here should be very carefully followed, making sure to have the attention of the child at all times. Under the exact conditions of the test, the ability to understand the task is made a part of the test. Common failures are giving the right-hand or left-hand weight each time, or giving both. The child understands

that he is to "give," as in other tests he understands that he is to "show" or "point out" something, but does not comprehend the rest.

V 4. *Making Rectangle With Two Triangles.* A Binet-Simon 1908 test, given here with practically the same procedure, except that three trials are given in place of one, which seems, however, to give but little different results.

A change in the positions of the cards from those described changes the test entirely. It can be made very much easier, or very much more difficult in this way. The examiner should, therefore, make sure that he is giving the test exactly as described. It is considered a trial in this test if the child moves the pieces about and then leaves them in any position. There is sometimes little or no evidence as to whether the child regards his effort as successful or not. In the great majority of cases the second and third trials are at once successful if the first one has been. The understanding of the task is a prominent part of the test.

V 5. *Repetition of a Sentence of Ten Words.* The Binet-Simon 1908 test used a sentence of sixteen syllables, which made it entirely too difficult for this age. The authors' 1911 revision substituted a sentence with ten syllables. The first sentence used here is taken from the Binet-Simon tests, the third from Terman, and the second is supplied by the writer. Terman gives the test in age-group IV, as an alternative test, using three sentences and requiring one correct repetition for a pass.

V 6. *Definitions According to Use of Objects.* A Binet-Simon 1908 test for age-group VI, using the word "mama" for "pencil" of the present test. The authors required three responses to be correct out of the five trials. Terman requires four correct out of six, the words used being "Chair, horse, fork, doll, pencil and table," and the test is placed in age-group V.

A child much brighter than a normal five or six-year-old may refuse to respond because the task seems too simple and childish to him. On the whole the responses may be

grouped into three classes. (a) Silence, or simple repetition, as "A fork is a fork," or poorer yet, merely "Fork." (b) Definitions in terms of use alone, as "A table is to eat," "A horse is to pull wagons." (c) Definitions better than in terms of use, as, "A horse is an animal that pulls wagons," or, "A horse has four legs, a head and a tail." The great majority of definitions better than according to use are descriptive or analytical in character. The logical form of definition is not given by children of this age, and but rarely by children much older.

V 7. *Tapping Blocks in Irregular Order.* This is a modification of a test used by Knox¹ and standardized by Pintner,² who used a series of this kind of test for different higher ages. It has the advantage of simplicity, and independence of language and of training. The adaptation to this age was made by Miss Merrill.

V 8. *Naming the Primary Colors.* In the Binet-Simon 1908 scale this was placed in age-group VIII, where it was entirely too easy. It is used here as given by Terman. It is not at all a test of ability to discriminate colors. The child learns to discriminate the colors used here, and undoubtedly many more much earlier. But he does not learn the color names much earlier, and the test is a test of the knowledge of color names. However, like the knowledge tested in a number of other tests in this system, so here, its acquisition before a given age depends on a number of factors in mental development, and the test becomes indirectly a test of these factors.

VI 1. *Distinction Between Right and Left.* In the Binet-Simon 1908 scale only right hand and left ear are called for. In the writer's 1912 revision the test was changed to its present form, which is used also by Terman.

A frequent error consists of choosing the same side the second time as the first, or the same the third time as the second. This often happens when the child is quite able to

1. Knox, H. A. *Journal of American Medical Association*, March 7, 1914.
2. Pintner, R. *Psychological Review*, September, 1915.

distinguish right from left, and is probably due to his attention being caught by the different parts called for, ear instead of hand, eye instead of ear, so that he does not notice the different side also that is called for. The natural tendency then is to choose the same side as before. For this reason the second trial is given.

VI 2. *Aesthetic Comparison*. A Binet-Simon 1908 test in the same form as given here, except that the authors allowed only one trial for each pair of pictures and required all three responses to be correct. Terman adheres to the authors' scoring, but places the test in age-group V. Failure in this test consists of absence of response through inability to understand at all what is to be done, or of pointing indiscriminately at any part of the card, or persistently choosing the right or left one. There is a strong tendency to do the last, which more or less frequently seems to be due to accidental inattention. For this reason a second trial on each pair is allowed.

VI 3. *Distinction Between Morning and Afternoon*. A Binet-Simon 1908 test. Failure usually is in the form of repeating the last word of the question. The ability to pass the test, therefore, involves the ability to overcome this tendency to repeat the last word, which is unusually strong in this test. This fact also reduces very largely the factor of chance that enters in producing a given percentage of correct responses.

VI 4. *Recognition of Mutilation in Pictures*. A Binet-Simon 1908 test used in age-group VII. The authors do not state the number of correct responses required for a pass. Terman uses different questions in the procedure, requires three out of four correct responses, and uses the test in age-group VI.

The child frequently fails to understand at first what is wanted, and the latter part of the procedure becomes necessary. Often he will say that the neck or body is gone, not having understood the question fully. Various other irrelevant answers are given. With the additional help for

the first picture, however, the responses for the remaining three should be prompt, and given without any further suggestions of any sort from the examiner.

VI 5. *Execution of Three Simultaneous Commands.* Used in the Binet-Simon 1908 scale in essentially the same form as here.

VI 6. *Counting Irregular Series of 4-6 Taps.* A new test. Mere counting, counting a regular series of sounds or group of regularly arranged seen objects, and counting an irregular series of sounds involve vastly different mental processes. The last can readily be made a difficult task for adults. This test is repeated in age-group X in more difficult form. It was suggested by the other counting tests. It has proven to be a very good one, but its success depends on the care taken by the examiner in doing the tapping correctly. The exact rate of taps and pauses is of the first importance. The examiner should frequently verify his rate with a watch. The tapping is best done by a wrist motion only, making the same motion for the pauses as well, only not allowing the pencil to strike the table.

VI 7. *Folding a Square of Paper Three Times.* A new test. It is important in such a test that the foldings be of such a nature as not to resemble anything likely to be given as kindergarten training, otherwise the effect of such training would undoubtedly cause individual variations in the results, independently of the stage of mental development.

VI 8. *Tapping Blocks in Irregular Order.* A new test, standardized by Pintner. It is used in the same form here as recommended by Pintner, who found 83 per cent. of normal six-year-olds passing it."¹ It is a test success in which depends especially on close momentary attention to the order of the blocks being tapped and keeping in mind this order until it can be reproduced. This makes it essential to take special precaution to get the child's best attention for each trial. The task, however, is much more inter-

1. Pintner, R. *The Standardization of Knox's Cube Test.* Psychological Review, 1915.

esting to children than might be supposed, and good attention is usually readily obtained.

VII 1. *Description of Pictures.* A Binet-Simon 1908 test, used here with different pictures, and modified question. The authors do not state whether they required a description for a response for only one or more than one of the three pictures. In my 1912 revision different pictures were used which did not call forth a description quite as readily as do the present pictures. In the 1912 revision a description for only one of the pictures scored a pass, which results showed to be correct scoring. With the present pictures description for two is required for passing, due to the pictures being easier. Terman using still different pictures, and with a content somewhat less familiar to seven-year-old children, also requires description for two for a pass.

The object in the test is to determine whether the child is capable of more than mere enumeration, and the form of the question is adapted to bring out description or interpretation. The pictures, being the same as those used in age-group III, are so chosen that they lend themselves readily to either enumeration or description. The present pictures are not well adapted for testing the capacity for interpretation, which appears at a considerably higher level of development.

VII 2. *Naming the First Four Coins.* A Binet-Simon 1908 test, substituting the American coins first suggested by Goddard. It is possible that it would make some difference whether the old or the new coins of these denominations are used. None, however, has been detected from general observation in giving this test. The recognition is undoubtedly mostly by size and general appearance instead of by designs and legends.

VII 3. *Telling Number of Fingers.* A Binet-Simon 1908 test, used in the original form here.

VII 4. *Repetition of Five Numerals.* A Binet-Simon 1908 test. The authors caution the examiner about reading the numerals in the several tests of this sort at the given

uniform rate of two numerals a second independently of the length of the series. In the present tests this rate is increased with the length of the series, which, we believe, gives a more favorable condition for correct recall, or at least offers a more uniformly favorable condition for recall in series of different lengths.

VII 5. *Comparing Two Objects From Memory.* Binet-Simon used this test in age-group VIII, with essentially the same procedure as given here, except that they used "Paper" and "Cardboard" for the last comparison, in place of "Stone" and "Egg." The substitution used here is taken from Terman. It gives much more uniform results.

The object of the test is to determine whether the child can make a correct comparison from memory. No exact definitions, pointing out essentials, or important differences, are required. Any difference that is really correct is satisfactory for an answer.

VII 6. *Giving Word Opposites.* This is new in the Binet-Simon scale, but has been used in various forms by different writers and for a variety of purposes. It has proven to be an exceptionally good test for this age, and can be used in one or two higher age-groups, when a higher score is required. Children much below seven usually fail completely, apparently because of inability to comprehend the task. This inability appears at times with seven-year-olds. Many do not understand the term "Opposite," and the illustrations given are a very essential part of the procedure. The particular words used, also, is of the first importance, as well as the form of the association test. A word-opposite association test in another form is used again below for much higher age levels. In this a list of printed words is presented to the subject simultaneously, who is then required to give the opposite as fast as he can. Some of the same words are used, but the changed form of the test calls for and makes possible a quite different mental operation.

VII 7. *Repeating Three Numerals Backwards.* This test was suggested by Bobertag and standardized for the Binet-Simon scale by Terman. It is used here in the same form as given by the latter.

VII 8. *Copying a Diamond.* A Binet-Simon 1908 test. It is like the one on drawing a square and placed in age-group V, having been standardized for pen and ink. But for the diamond as for the square, if the child fails with pen and ink he usually fails also when a pencil is substituted, except in cases of motor disturbances. The drawings made by the child should always be carefully compared with the samples in scoring.

VIII 1. *Counting the Value of Stamps.* Binet-Simon used coins, three simple and three double sous, for this test. The stamps, suggested by Goddard, do not seem to change the test in any respect.

The most frequent failure consists in simply counting the number of stamps. Giving any number at once in mere guessing is also common. The ability to be tested is that of performing the simple arithmetical operation involved, and, if the child does not know the value of the individual stamps, he must be told. This also largely removes the influence of variable training, which might otherwise possibly be a fault in this test.

VIII 2. *Size of Vocabulary.* This is one of Terman's new tests, who uses it in several different age-groups. He says of it: "The vocabulary test has a far higher value than any other single test in the scale. . . . Our statistics show that in a large majority of cases the vocabulary test alone will give us an intelligence quotient within ten per cent. of that secured by the entire scale." Only half of his list of words is given here, as this is more than is ever needed for eight-year-olds. The writer's experience confirms in the main Terman's remarks about the value of the test, but the score of twenty words satisfactorily defined for eight-year-olds seems somewhat high. Feeble-minded with a mental age of eight as a rule fall

considerably short of getting twenty words. Terman's results with normal eight-year-olds shows an average of 59 per cent. passing.

VIII 3. *Counting Backwards From Twenty to One.* A Binet-Simon 1908 test. The procedure is slightly changed, and the authors also did not allow more than twenty seconds for counting under any circumstances. The test fulfills well the chief conditions of a good test. At the same time, its value can be quite destroyed in individual cases through training or lack of it. It is unquestionably just as easy to learn to say this series backwards as it is forwards, if the first and only training is in saying it backwards. On the other hand, it would be very difficult to say it backwards in twenty seconds if one had never tried it before. The test probably gains its value through the fact that all children learn to count forwards readily and get the associations thoroughly fixed in this direction, and also get sufficient training before the age of eight years in counting backwards to learn to do so if they can learn at all. The test then becomes a test of the ability to learn to break up or reverse a well-fixed series of associations.

VIII 4. *Comprehension.* A new test. The several trials of this test being quite the same in nature, the child usually fails outright in all or passes in all, or in all but one or two, the failure in one or two being probably due to poor attention rather than to inability to comprehend. Children much younger than eight years almost invariably fail altogether, possibly because they are not familiar with the terms, "Upper right," etc. But familiarity with terms used and ability to comprehend the task the terms describe are not independent in this test any more than in a number of the others. Terms become familiar, on the whole, as fast as the power to analyze and comprehend develops.

VIII 5. *Giving Word Opposites.* New, same as VII 6.

VIII 6. *Giving Similarities.* Suggested first by Bober-

tag for the Binet scale, and standardized by Terman. It is given and scored here according to the latter's directions.

VIII 7. *Folding a Square of Paper Five Times.* New. The test is the same as VI 7, made more difficult by requiring five instead of three folds to be reproduced.

VIII 8. *Counting Dots.* New. A number of different dot counting tests were tried out, many turning out very poorly, while the present one gives very good results. The essentials seem to be irregularity in arrangement of dots, right numbers and spacing in each group, right number of groups, possibility of a continuous counting process, and adaptation of these to the ages for which the test is to be used.

IX 1. *Giving the Date.* A Binet-Simon 1908 test, given and scored here in the same way as by the authors. The criticism often made against this test that training, accidental knowledge or lack of it, is too large a factor does not apply in any serious degree. The fact that normal adults frequently do not know the exact day of the month is due to the fact that they often have no interest or motive for remembering. Normal children, however, at this age seem to have a natural interest in the date, and have the necessary intelligence to keep track of it.

IX 2. *Arrangement of Weights.* A Binet-Simon 1908 test. The authors' procedure is somewhat changed here, as are also the weights used. The weights in the present series are 6, 12, 18, 24 and 30 grams. The authors used a series of 3, 6, 9, 12 and 15 grams. The test has been used in a number of slightly varied forms both as to the weights themselves and the procedure in giving the test. There are some objections to using a weight as light as three grams. In the procedure it is important to have directions that are brief, easily intelligible, and that will lead to uniformity of method with different children in choosing the weights. The directions are therefore broken up into several steps, each of them by itself quite brief, and an illustration is given in lifting the weights. Nine-year-old children are still

too young to listen with sustained attention to lengthy directions, and there are several very poor ways of lifting the weights which many children will accidentally follow if they are left to choose their own, and, therefore, fail in the test.

IX. 3. *Using Three Words in a Sentence.* Used by Binet-Simon in age-group X, with considerably different procedure. The words used were "Paris, fortune and river," and the child was asked to write the sentence. Children can be easily coached on this test, and three different groups of words are given here, any one of which may be used. Results with the second and third groups have been compared with those of the first group, and no apparent difference has been found.

The responses obtained in this test may be divided into several classes. (a) Using only one or two of the words and omitting the other entirely. (b) Making three separate sentences or one with the three independent parts joined by "and," like "Money is to buy things with; the river is deep, and St. Paul is a big city." (c) Making two sentences, expressing two separate ideas, like: "St. Paul is on the river, and there is lots of money." (d) Making one sentence, expressing only one idea, like: "I lost some money on the river at St. Paul." Only sentences belonging to one of the last two classes are accepted as satisfactory.

IX. 4. *Making Change.* Used by Binet-Simon in a quite different form. In the authors' original test the examiner proposed playing store with the child. A variety of coins and some articles were placed before the child. The examiner then proposed to buy a box for four sous, gave the child a one-franc piece and requested him to give back the correct change. In Goddard's adaptation of the test for American coins, the test is kept in this form, the examiner buying something for nine cents, and requiring the child to return the correct change out of twenty-five cents. In the writer's 1912 revision of the scale this test was changed to the present form, which is practically the same as used now

by Terman. The test in this form is much easier to give than the original, and seems to be equally good.

IX 5. *Definition Better Than According to Use.* A Binet-Simon 1908 test for age-groups VI and IX. The authors give only the list of words used in age-group VI, and no separate list for IX. In using this six-year list for a nine-year test the writer frequently found that the child would not respond at all, apparently because the questions "What is a fork?" etc., seemed too childish for children with mental ages of about nine. In my 1912 revision the words "Telephone, balloon, football, tiger and battleship" were used for this test in age-group IX. Terman uses the words "Balloon, tiger, football and soldier," places it in age-group VIII, and requires two satisfactory definitions out of the four.

For a classification of the different kinds of responses, see V 6. The great majority of satisfactory responses describe some trait of the object, as size, shape and how it is made. A still higher form than the descriptive is the logical form, such as: "A telephone is a thing used to talk to a person far away." This is rarely given at this age. A little experience in observing the kinds of definitions usually given at the age of five as compared with those given at this age usually removes any difficulty in classifying.

IX 6. *Comprehension.* A new test. General observation in giving this test to a number of children of different ages leaves an unfavorable impression as to its value. This is because younger children who pass this test often succeed readily in all six trials, while older children who fail, often fail entirely in all trials. This results from the fact that the several trials are all quite of the same nature. A small minority fail in the first few trials and then seem to comprehend the task for the remaining trials. With the method of scoring used, there is a satisfactory increase in the percentage of children eight, nine and ten years old that pass it.

IX 7. *Repeating Four Numerals Backwards.* Taken from Terman's revision of the scale, and given here in the

same form, except that the numbers are slightly changed. See VII 7 for further comment.

IX 8. *Counting Dots*. New. See VIII 8 for comments.

X 1. *Drawing Designs From Memory*. Used by Binet-Simon in their 1905 series of tests and in their 1911 revision. The designs used here and the procedure are identical with those of Binet-Simon.

X 2. *Counting Dots*. See above.

X 3. *Spelling Familiar Words Backwards*. New. This test was suggested by the one on repeating numerals backwards. The mental processes involved are probably quite similar in the two. But for these higher mental levels the test on repeating numerals backwards necessarily changes considerably in character because of the longer series of numerals that is required. In these longer series the subject often forgets what the series were forwards. This difficulty is removed in the present test, but another is met in the fact that occasionally children of sufficient intelligence to otherwise pass the test are not able to spell the words forwards.

X 4. *Counting Irregular Series of 9-12 Taps*. New. Great care is necessary on the part of the examiner in doing the tapping correctly. The exact rate of taps and pauses is of the first importance. The examiner should frequently verify his rate with a watch, practicing particularly on allowing just one second for a square. The tapping is best done by a wrist motion only, making the same motion for the blank squares and pauses, only not allowing the pencil to strike the table. For further comment see VI 6.

X 5. *Detection of Absurdities in Absurd Statements*. Used by Binet-Simon in age-group XI in their 1908 scale and changed to X in their 1911 revision. They used the following five statements, requiring three to be answered correctly for a pass.

(1). "An unfortunate bicycle rider fell on his head and was killed instantly; he was taken to a hospital and they fear he will not recover."

(2). "I have three brothers, 'Paul, Ernest and myself.'"

(3). "The body of an unfortunate young girl, cut into eighteen pieces, was found yesterday on the fortifications. It is thought that she killed herself."

(4). "There was a railroad accident yesterday, but it was not a bad one; the number of dead is only 48."

(5). "Someone said: 'If I should ever grow desperate and kill myself, I will not choose Friday, because Friday is an unlucky day and will bring me unhappiness.'" ¹

Whipple objected to some of these because they were too "blood-curdling." I have found the last somewhat unsatisfactory because it allows of interpretations that do away with the nonsense, and children often give these interpretations. In the present form of the test the first three are retained, the last two are dropped, while the third given here is borrowed from Terman.

X 6. *Giving the Associated Numbers for the Dissected Parts of a Simple Form.* This is a modification of a test used by Healy.² In the code test used by Healy four forms are required to furnish a part for each of the alphabet. The first of these is the same as one in the present test with the letters a to i. The second is a duplicate but adds a dot in each part, and has the letters j to r. The third is a large X with the letters s to v. The fourth is the same as the third but adds a dot in each part, and has the letters w to z. In the test the child is shown all the forms together with the letters in them. They are then removed and he is required to write a brief code message in them by drawing the parts only that contained the letters required in the message. The code test is more interesting than the present one, and more

1. From the translation of the Binet-Simon 1911 revision by Clara Harrison Town.

2. Healy, W., and Fernald, Grace Maxwell. *Tests for Practical Mental Classification.* Psychological Review Publications. Psychological Monographs, March, 1911.

difficult. An objection to it is that it is quite likely to be communicated and become familiar to children of a group before all are examined. The writer also found considerable difficulty in finding a simple explanation for the test which children would grasp readily, which made really two tests of it; first the test on the ability to comprehend the explanation, and second the test on the ability to use the code. The present test has been tried out with various forms of procedure, chiefly to remove the difficulty so many children had of understanding what they were to do, and of recognizing at once that the dissected parts were parts of the whole figure. The present procedure is longer than others that have been tried, but removes the difficulty in question entirely. It is not a memory test, except possibly to a very small degree. It calls for the ability to grasp the plan of the numbering of the parts, which, when once understood, cannot be forgotten in the course of the test, and for the ability to re-image the figure to mentally find the number for each part.

X 7. *Crossing out q, r, s, t in pied text.* New. This test was at first intended for higher age-groups only, for which it was tried out in most of its forms as usually found in the literature. It went through a great number of changes. The present features which have made it a success are the following: (a) Reduction of the amount of text to about a fourth of what is often used. The task is very fatiguing to the eyes. (b) Changing the style of letter, size of letter, letter and line spacing, and length of line, to conform to conditions found by psychologists to be most favorable to easy legibility. (c) Making the mental processes involved much more complex, and less mechanical, by calling for four letters to be crossed out instead of one, and by having each crossed out in a different way. (d) Giving the subject definite rules and conditions for the work, as given in the directions. (e) Placing it in the present age groups, and limiting it to them. (f) The present method of scoring.

X 8. *Giving the word opposites.* New. This test in the same or different forms has been used by various writers on many different occasions. It is here introduced into the Binet-Simon scale for the first time. From the standpoint of discriminative capacity and especially range of applicability in a number of different age-groups, it is one of the best in the scale. Though in several respects the same as the word opposites test used in age-groups VII and VIII, it involves quite different mental processes and thereby becomes applicable for these higher ages. The subject here has all the words before him, simultaneously, which gives the possibility of thinking of more than one word at a time, and thereby reduces the association time materially. A good score in this test depends on the ability to control several mental processes simultaneously, of which the younger child is quite incapable.

The examiner has some difficulty in giving this test until after a little practice. A good way is to place the stop watch close to the duplicate list of words for the examiner, and then while following the words with one hand, keep a pencil over the dial of the stop watch with the other; and each time the subject gives a word place the pencil ten seconds ahead of the moving second hand. In this way the error made in judging when the ten seconds are up for a word is hardly ever much over a second, which is quite accurate enough for the test. If a split-second stop watch is used all difficulty is entirely removed.

XI 1. *Words to put in order to make a sentence.* A Binet-Simon 1908 test, just as given here, except that the authors allowed only one minute for getting a sentence, and did not use the first for an illustration when found necessary. The present form makes it an easier test, but according to our results it is correctly placed in this age-group when used in this way. Terman, following the author's procedure in giving the test, places it in age-group XII. Failure to get the first sentence is often due to the child's not understanding what is to be done, hence, the first one

is given to him as an illustration, if he fails in it. Also, he will sometimes get the sentence quite readily, excepting that he will omit a word or alter it slightly. This is largely accidental, but slightly related to his ability, and should not at once be counted as a failure for the sentence. Again, children who are merely "slow" but intelligent, need more than a minute for a sentence, which is what has usually been allowed in this test.

XI 2. *Repeating one or two sentences with twenty-four syllables.* Binet-Simon gave five trials on this test, placed in age-group XII. The lengths of the sentences used were 24, 26, 28, 30 and 32 syllables, respectively, for the five trials. The sentences used were as follows:

(1) "My children, one must work very hard in order to live; one must go to school every morning."

(2) "The other day I saw in the street a little yellow dog. Little Maurice has soiled his new apron."

(3) "Earnest is often punished for his naughty conduct. I bought at the store a pretty doll for my little niece."

(4) "That night there was a terrible storm of lightning. My companion has taken cold, he has a fever and coughs very much."

(5) "The tram car is cheaper than the omnibus; it costs only two cents. It is droll to see women driving coaches in Paris."¹

Binet-Simon required the twelve-year-old to repeat a sentence of 26 syllables or more in order to pass the test. Terman uses sentences of 22 syllables, gives three trials, and places the test in age-group X, one correct repetition passing the test. The present writer has found that the exact nature and content of the sentences used is, within limits, as important as is the length. The third sentence used here is still objectionable in respect to form and content. Although of the same length as the others, it is much more difficult.

1. From translation by Elizabeth S. Kite, in *The Development of Intelligence*, by Alfred Binet and T. H. Simon. Publications of the Training School at Vineland New Jersey. Department of Research. No. 11, May, 1916.

XI 3. *Giving definitions of abstract terms.* Binet-Simon used the words "Charity, justice, and goodness" only, requiring two to be satisfactorily defined. In my 1912 revision the words "Charity, justice, bravery, revenge, kindness" were used, requiring three to be satisfactorily defined. Terman uses "Pity, revenge, charity, envy, justice," and requires three satisfactory definitions, but places it in age-group XII.

Any test that involves the ability to think in abstract terms, or to generalize in the simplest manner, is of special value in discriminating older children and adults that are mentally defective from the normal. Inability in this line is one of the most prominent distinguishing traits of the high-grade feeble-minded. This test is especially valuable for this reason. The beginner has some difficulty in scoring responses which makes it less satisfactory in this respect.

XI 4. *Giving the associated number for the dissected parts of a simple form.* See X 6 for comments.

XI 5. *Crossing out q, r, s, t in pied text.* See X 7 for comment.

XI 6. *Simple Arithmetical Problems.* New. In getting the norms for this test it was given as a group test to fifteen to thirty children at a time. The procedure, from the standpoint of the child, however, was so nearly the same as when given to one alone as to make it unlikely that the norms are seriously too high or too low. It is undoubtedly affected some by training and practice, which gives it a larger individual variation in the scores made by children of any given age than is true of some of the other tests.

XI 7. *Giving Word Opposites.* See X 8 for comments.

XI 8. *Immediate Recall of Unfamiliar Forms.* New. Although a memory test in form, the task involved here calls for a maximum concentration of attention and effort, both in memorizing during the ten seconds, and in the recall immediately afterwards. It is chiefly to this aspect, undoubtedly, rather than to the memory factor, that its value

as an intelligence test is due. The arbitrariness and meaninglessness of the forms, the construction of the series according to a definite rule, and the procedure are essential features of the test. It is applicable over a wide range of years, giving regularly increasing scores from younger to older subjects.

XII 1, 2, 3 4, 5, 6. See above for comments.

XII 7. *Following directions in a confusing Text.* New in the Binet-Simon scale. The test is taken from a Columbia University study in which the results have shown a high correlation with general mental ability. A minor change in the procedure to make plain to younger subjects what they were to do in the test, and a slight change in the text at the end were found necessary.¹

XII 8. *Locating Sections of a Divided Square From Description.* New. This test was suggested by the difficulty children of this age, and older, often have in following descriptions used to locate land in our system dividing it into townships, sections, and parts of sections. This test, though simple in comparison, has been found difficult enough when quickness of comprehension is made a factor. The directions requesting the subject to take the description backwards is very essential, as this method makes it much easier and is one into which some fall at once, while others do not, independently of their general abilities.

XIII to XV 1; 2, 3, 4, 5. See above for comments.

XIII to XV 6. *Drawing Triangles on Squares According to Directions.* New. Toulouse and Pieron² use tests somewhat similar to this to measure "comprehension," which suggested the present procedure of drawing triangles on squares according to description. It is immaterial whether the test is properly named. It has fulfilled the requirements of a test quite well, but has not the range of application that some of the others here have. When used

Woodrow, R. S., and Wells, F. L. *Association Tests.* Psychological Review Publications. Psychological Monographs, December, 1911.

2. See *Technique de Psychologie Experimentale*, 1911.

on younger subjects an age is soon reached where all fail entirely in the task set here.

XIII to XV 7. *Drawing Upright Forms in Inverted Positions.* New. This test is as difficult on the whole as any in the system. It is intended to give a task that involves constructive imagination chiefly, intensive directed thinking towards a definite end. But an adequate analysis of the processes involved cannot at present be given any more than for most of the other tests. It has been tried out in a variety of forms, the present form proving the most satisfactory. There is considerable individual variability in the results, but on the whole subjects much below thirteen fail entirely. This test and the next one have not been as thoroughly standardized as have the others. It is probable that the average scores would show improvement considerably beyond the age of fifteen, but our results so far are inadequate to show this positively.

XIII to XV 8. *Making Logical Inferences.* New. The original aim of this test needs no explanation. The syllogism is the stock illustration of logical inference. It should not be understood, however, that reasoning power in general can be at all adequately measured by such tests alone. This test also has been tried out in a number of forms before a satisfactory procedure was found. It was suggested by the test given by Toulouse and Pieron using syllogisms to test reasoning. Since experimenting with it was begun other syllogism tests have been standardized by other writers. I have considered it important to have the syllogism in this abstract form, instead of giving it concrete content, such as "All men are mortal; Socrates is a man," etc. If put in this concrete form there is always the possibility that the subject will accept or reject a given conclusion directly, instead of going through the process of reasoning from the premises given.

**MATERIALS REQUIRED FOR TESTS BELOW
AGE-GROUP III.**

One-inch cube, or other small object.
Two telegraphic snappers.
Electric flash lamp, or other very bright object.
Candle.
Pillow, or similar support for back in sitting.
Hand bell, about two inches in diameter.
Ball, one and a half to two inches in diameter.
Baby rattle.
Colored pictures of baby, older persons, domestic animals, such as may be found in children's picture books or in magazine advertisements.
Glass of water.
Glass of milk.
Bowl of bread and milk, or other food, with spoon.
Plate and fork, with any suitable food.
Bread and slightly weakened vinegar.
Lump sugar, or candy.
Four-inch squares of tissue paper.

APPENDIX

TABLE OF INTELLIGENCE QUOTIENTS

The following intelligence quotient table gives these quotients from 25 to 150, for the ages of three years to maturity, and the mental ages of three to fifteen, inclusive. The figures at the top of the table give the mental ages in terms of years and eighths of a year. The first column on the left in the table gives the chronological ages in years and months. Since the scale has eight tests in each age group, the fractions of a year in the mental ages are given, of course, in eighths. By not reducing these to terms of months to correspond to the way of expressing the chronological age, an operation is eliminated for both age and mental age in finding the intelligence quotient. In using this table to find the I. Q. of a case, his age is left in terms of years and months, and his mental age is left in terms of years and eighths of a year. For example, assume a case with an age of twelve years and seven months, and with a mental age of eight and five-eighths of a year. You look under VIII, column 5, down to age 12 years 7 months, and find the I. Q. of 69.

When not all eight tests in each age-group have been used in making an examination this I. Q. table may be used with the aid of the following figures, giving the reduction of different fractions of a year in mental age, the half, third, fourth, fifth, sixth and seventh of a year, to eighths.

| | 2 | 3 | 4 | 5 | 6 | 7 |
|--------|---|-----|---|-----|-----|-----|
| 1..... | 4 | 2.7 | 2 | 1.6 | 1.3 | 1.1 |
| 2..... | | 5.3 | 4 | 3.2 | 2.7 | 2.3 |
| 3..... | | | 6 | 4.8 | 4.0 | 3.4 |
| 4..... | | | | 6.4 | 5.3 | 4.6 |
| 5..... | | | | | 6.7 | 5.7 |
| 6..... | | | | | | 6.9 |

The first row of figures at the top gives the number of tests per age-group that may have been used in an examination. The figures below these give the number of eighths in each fraction of a year from a half to a seventh. Thus, two-fifths of a year equal 3.2 eighths, three-fifths equal 4.8 eighths, and so on. Suppose that six tests only of each age-group had been used in an examination of a case aged ten years and five months, giving a mental age of seven and five-sixths years. Five-sixths equals 6.7 eighths of a year. In the I. Q. table we find the I. Q.'s at this age for the next higher and next lower mental ages, that is, for 7 7-8 and 7 6-8, which are 76 and 74, respectively. The I. Q. for this case is, therefore, 74 plus .7 (76-74), or 75.4. A little familiarity with the I. Q. table will show that one can usually tell at once by inspection whether it is necessary to go through this operation or not. In very many instances it is at once obvious that the difference between two such adjacent I. Q.'s is not sufficient to add as much as a point to the I. Q.

| III | | | | | | | | | | | | | | IV | | | | | | | | | | | |
|-----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|--|--|--|--|--|--|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | | | |
| 3 | 0 | 100 | 104 | 109 | 113 | 117 | 121 | 125 | 129 | 133 | 138 | 142 | 146 | 150 | | | | | | | | | | | |
| | 1 | 97 | 102 | 105 | 110 | 114 | 118 | 122 | 126 | 130 | 134 | 138 | 142 | 146 | 150 | | | | | | | | | | |
| | 2 | 95 | 99 | 103 | 107 | 110 | 115 | 118 | 122 | 126 | 130 | 134 | 138 | 142 | 146 | 150 | | | | | | | | | |
| | 3 | 92 | 96 | 100 | 104 | 108 | 112 | 115 | 119 | 123 | 127 | 131 | 135 | 138 | 143 | 146 | 150 | | | | | | | | |
| | 4 | 90 | 94 | 98 | 102 | 105 | 109 | 113 | 117 | 120 | 124 | 128 | 132 | 135 | 139 | 143 | 147 | | | | | | | | |
| | 5 | 88 | 92 | 95 | 99 | 102 | 106 | 110 | 113 | 117 | 121 | 124 | 128 | 132 | 135 | 139 | 143 | | | | | | | | |
| | 6 | 86 | 89 | 93 | 97 | 100 | 104 | 107 | 111 | 114 | 118 | 121 | 125 | 129 | 132 | 136 | 139 | | | | | | | | |
| | 7 | 84 | 87 | 91 | 94 | 98 | 101 | 105 | 108 | 112 | 115 | 119 | 122 | 126 | 129 | 133 | 136 | | | | | | | | |
| | 8 | 82 | 86 | 89 | 92 | 96 | 99 | 102 | 106 | 109 | 113 | 116 | 120 | 123 | 127 | 130 | 133 | | | | | | | | |
| | 9 | 80 | 84 | 87 | 90 | 93 | 97 | 100 | 104 | 107 | 110 | 113 | 117 | 120 | 123 | 127 | 130 | | | | | | | | |
| | 10 | 78 | 82 | 85 | 88 | 91 | 95 | 98 | 101 | 104 | 108 | 111 | 114 | 118 | 121 | 124 | 127 | | | | | | | | |
| | 11 | 77 | 80 | 83 | 87 | 90 | 93 | 96 | 99 | 102 | 106 | 109 | 112 | 115 | 118 | 122 | 125 | | | | | | | | |
| 4 | 0 | 75 | 78 | 81 | 85 | 88 | 91 | 94 | 97 | 100 | 103 | 106 | 110 | 113 | 116 | 119 | 122 | | | | | | | | |
| | 1 | 73 | 77 | 80 | 83 | 86 | 89 | 92 | 95 | 98 | 101 | 104 | 107 | 110 | 114 | 116 | 120 | | | | | | | | |
| | 2 | 72 | 75 | 78 | 81 | 84 | 87 | 90 | 93 | 96 | 99 | 102 | 105 | 108 | 111 | 114 | 117 | | | | | | | | |
| | 3 | 71 | 74 | 77 | 80 | 82 | 85 | 88 | 91 | 94 | 97 | 100 | 103 | 106 | 109 | 112 | 115 | | | | | | | | |
| | 4 | 69 | 72 | 75 | 78 | 81 | 84 | 87 | 90 | 92 | 95 | 98 | 101 | 104 | 107 | 110 | 113 | | | | | | | | |
| | 5 | 68 | 71 | 74 | 77 | 79 | 82 | 85 | 88 | 91 | 93 | 96 | 99 | 102 | 105 | 108 | 110 | | | | | | | | |
| | 6 | 67 | 70 | 72 | 75 | 78 | 81 | 83 | 86 | 89 | 92 | 94 | 97 | 100 | 103 | 106 | 108 | | | | | | | | |
| | 7 | 66 | 68 | 71 | 74 | 76 | 79 | 82 | 85 | 87 | 90 | 93 | 96 | 98 | 101 | 104 | 107 | | | | | | | | |
| | 8 | 64 | 67 | 70 | 73 | 75 | 78 | 81 | 83 | 86 | 89 | 91 | 94 | 97 | 99 | 102 | 105 | | | | | | | | |
| | 9 | 63 | 66 | 68 | 71 | 74 | 76 | 79 | 82 | 84 | 87 | 90 | 92 | 95 | 98 | 100 | 103 | | | | | | | | |
| | 10 | 62 | 65 | 67 | 70 | 73 | 75 | 78 | 80 | 83 | 86 | 88 | 90 | 93 | 96 | 98 | 101 | | | | | | | | |
| | 11 | 61 | 64 | 66 | 69 | 71 | 74 | 76 | 79 | 82 | 84 | 87 | 89 | 92 | 94 | 97 | 99 | | | | | | | | |
| 5 | 0 | 60 | 63 | 65 | 68 | 70 | 73 | 75 | 78 | 80 | 83 | 85 | 88 | 90 | 93 | 95 | 98 | | | | | | | | |
| | 1 | 59 | 62 | 64 | 67 | 69 | 72 | 74 | 76 | 79 | 81 | 84 | 86 | 89 | 91 | 94 | 96 | | | | | | | | |
| | 2 | 58 | 61 | 63 | 65 | 68 | 70 | 73 | 75 | 77 | 80 | 82 | 85 | 87 | 90 | 92 | 94 | | | | | | | | |
| | 3 | 57 | 60 | 62 | 64 | 67 | 69 | 71 | 74 | 76 | 79 | 81 | 83 | 86 | 88 | 91 | 93 | | | | | | | | |
| | 4 | 56 | 59 | 61 | 63 | 66 | 68 | 70 | 73 | 75 | 78 | 80 | 82 | 84 | 87 | 89 | 92 | | | | | | | | |
| | 5 | 55 | 58 | 60 | 62 | 65 | 67 | 69 | 72 | 74 | 76 | 78 | 81 | 83 | 85 | 88 | 90 | | | | | | | | |
| | 6 | 55 | 57 | 59 | 62 | 64 | 66 | 68 | 71 | 73 | 75 | 77 | 80 | 82 | 84 | 86 | 89 | | | | | | | | |
| | 7 | 54 | 56 | 58 | 61 | 63 | 65 | 67 | 70 | 72 | 74 | 76 | 79 | 81 | 83 | 85 | 88 | | | | | | | | |
| | 8 | 53 | 55 | 58 | 60 | 62 | 64 | 66 | 69 | 71 | 73 | 75 | 77 | 80 | 82 | 84 | 86 | | | | | | | | |
| | 9 | 52 | 54 | 57 | 59 | 61 | 63 | 65 | 68 | 70 | 72 | 74 | 76 | 78 | 81 | 83 | 85 | | | | | | | | |
| | 10 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 67 | 69 | 71 | 73 | 75 | 77 | 79 | 82 | 84 | | | | | | | | |
| | 11 | 51 | 53 | 55 | 57 | 59 | 61 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 83 | | | | | | | | |

| III | | | | | | | | | | IV | | | | | | | | | |
|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| 6 | 0 | 50 | 52 | 54 | 56 | 58 | 61 | 63 | 65 | 67 | 69 | 71 | 73 | 75 | 77 | 79 | 81 | | |
| | 1 | 49 | 51 | 53 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | | |
| | 2 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 67 | 69 | 71 | 73 | 75 | 77 | 79 | | |
| | 3 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | | |
| | 4 | 47 | 50 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 67 | 69 | 71 | 73 | 75 | 77 | | |
| | 5 | 47 | 49 | 51 | 53 | 55 | 57 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | | |
| | 6 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 65 | 67 | 69 | 71 | 73 | 75 | | |
| | 7 | 46 | 48 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 67 | 68 | 70 | 72 | 74 | | |
| | 8 | 45 | 47 | 49 | 51 | 53 | 55 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 71 | 73 | | |
| | 9 | 45 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 59 | 61 | 63 | 65 | 67 | 69 | 70 | 72 | | |
| | 10 | 44 | 46 | 48 | 50 | 51 | 53 | 55 | 57 | 59 | 61 | 62 | 64 | 66 | 68 | 70 | 72 | | |
| | 11 | 43 | 45 | 47 | 49 | 51 | 53 | 54 | 56 | 58 | 60 | 62 | 63 | 65 | 67 | 69 | 71 | | |
| 7 | 0 | 43 | 45 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 59 | 60 | 62 | 64 | 66 | 68 | 69 | | |
| | 1 | 42 | 44 | 46 | 48 | 49 | 51 | 53 | 55 | 56 | 58 | 60 | 62 | 64 | 65 | 67 | 69 | | |
| | 2 | 42 | 44 | 45 | 47 | 49 | 51 | 52 | 54 | 56 | 58 | 59 | 61 | 63 | 65 | 66 | 68 | | |
| | 3 | 41 | 43 | 45 | 47 | 49 | 50 | 52 | 54 | 55 | 57 | 59 | 60 | 62 | 64 | 66 | 67 | | |
| | 4 | 41 | 43 | 44 | 46 | 48 | 50 | 51 | 53 | 55 | 56 | 58 | 60 | 61 | 63 | 65 | 67 | | |
| | 5 | 40 | 42 | 44 | 46 | 47 | 49 | 51 | 52 | 54 | 56 | 57 | 59 | 61 | 62 | 64 | 66 | | |
| | 6 | 40 | 42 | 43 | 45 | 47 | 48 | 50 | 52 | 53 | 55 | 57 | 58 | 60 | 62 | 63 | 65 | | |
| | 7 | 40 | 41 | 43 | 45 | 46 | 48 | 50 | 51 | 53 | 55 | 56 | 58 | 59 | 61 | 63 | 64 | | |
| | 8 | 39 | 41 | 42 | 44 | 46 | 47 | 49 | 51 | 52 | 54 | 56 | 57 | 59 | 60 | 62 | 64 | | |
| | 9 | 39 | 40 | 42 | 44 | 45 | 47 | 48 | 50 | 52 | 53 | 55 | 57 | 58 | 60 | 61 | 63 | | |
| | 10 | 38 | 40 | 42 | 43 | 45 | 46 | 48 | 50 | 51 | 53 | 54 | 56 | 58 | 59 | 61 | 62 | | |
| | 11 | 38 | 40 | 41 | 43 | 44 | 46 | 47 | 49 | 51 | 52 | 54 | 55 | 57 | 59 | 60 | 62 | | |
| 8 | 0 | 38 | 39 | 41 | 42 | 44 | 45 | 47 | 49 | 50 | 52 | 53 | 55 | 56 | 58 | 59 | 61 | | |
| | 1 | 37 | 39 | 40 | 42 | 43 | 45 | 46 | 48 | 50 | 51 | 53 | 54 | 56 | 57 | 59 | 60 | | |
| | 2 | 37 | 38 | 40 | 41 | 43 | 44 | 46 | 48 | 49 | 51 | 52 | 54 | 55 | 57 | 58 | 60 | | |
| | 3 | 36 | 38 | 39 | 41 | 42 | 44 | 46 | 47 | 49 | 50 | 52 | 53 | 55 | 56 | 58 | 59 | | |
| | 4 | 36 | 38 | 39 | 41 | 42 | 44 | 45 | 47 | 48 | 50 | 51 | 53 | 54 | 56 | 57 | 59 | | |
| | 5 | 36 | 37 | 39 | 40 | 42 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 53 | 55 | 56 | 58 | | |
| | 6 | 35 | 37 | 38 | 40 | 41 | 43 | 44 | 46 | 47 | 49 | 50 | 52 | 53 | 55 | 56 | 57 | | |
| | 7 | 35 | 37 | 38 | 39 | 41 | 42 | 44 | 45 | 47 | 48 | 50 | 51 | 53 | 54 | 55 | 57 | | |
| | 8 | 35 | 36 | 38 | 39 | 40 | 42 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 54 | 55 | 56 | | |
| | 9 | 34 | 36 | 37 | 39 | 40 | 42 | 43 | 44 | 46 | 47 | 49 | 50 | 51 | 53 | 54 | 56 | | |
| | 10 | 34 | 36 | 37 | 38 | 40 | 41 | 43 | 44 | 45 | 47 | 48 | 50 | 51 | 52 | 54 | 55 | | |
| | 11 | 34 | 35 | 37 | 38 | 39 | 41 | 42 | 44 | 45 | 46 | 48 | 49 | 51 | 52 | 53 | 55 | | |

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| | | III | | | | | | | | IV | | | | | | | |
|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9 | 0 | 33 | 35 | 36 | 38 | 39 | 40 | 42 | 43 | 44 | 46 | 47 | 49 | 50 | 51 | 53 | 54 |
| | 1 | 33 | 35 | 36 | 37 | 39 | 40 | 41 | 43 | 44 | 46 | 47 | 48 | 50 | 51 | 52 | 54 |
| | 2 | 33 | 34 | 35 | 37 | 38 | 40 | 41 | 42 | 44 | 45 | 46 | 48 | 49 | 51 | 52 | 53 |
| | 3 | 32 | 34 | 35 | 37 | 38 | 39 | 41 | 42 | 43 | 45 | 46 | 47 | 49 | 50 | 51 | 53 |
| | 4 | 32 | 34 | 35 | 36 | 38 | 39 | 40 | 42 | 43 | 44 | 46 | 47 | 48 | 50 | 51 | 52 |
| | 5 | 32 | 33 | 35 | 36 | 37 | 39 | 40 | 41 | 43 | 44 | 45 | 47 | 48 | 49 | 50 | 52 |
| | 6 | 32 | 33 | 34 | 36 | 37 | 38 | 40 | 41 | 42 | 44 | 45 | 46 | 47 | 49 | 50 | 51 |
| | 7 | 31 | 33 | 34 | 35 | 37 | 38 | 39 | 41 | 42 | 43 | 44 | 46 | 47 | 48 | 49 | 51 |
| | 8 | 31 | 32 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 43 | 44 | 45 | 46 | 48 | 49 | 50 |
| | 9 | 31 | 32 | 34 | 35 | 36 | 37 | 39 | 40 | 41 | 42 | 44 | 45 | 46 | 48 | 49 | 50 |
| | 10 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 40 | 41 | 42 | 43 | 45 | 46 | 47 | 48 | 50 |
| | 11 | 30 | 32 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 42 | 43 | 44 | 45 | 47 | 48 | 49 |
| 10 | 0 | 30 | 31 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 43 | 44 | 45 | 46 | 48 | 49 |
| | 1 | 30 | 31 | 32 | 34 | 35 | 36 | 37 | 39 | 40 | 41 | 42 | 44 | 45 | 46 | 47 | 49 |
| | 2 | 30 | 31 | 32 | 33 | 34 | 36 | 37 | 38 | 39 | 41 | 42 | 43 | 44 | 46 | 47 | 48 |
| | 3 | 29 | 31 | 32 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 42 | 43 | 44 | 45 | 46 | 48 |
| | 4 | 29 | 30 | 31 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 42 | 44 | 45 | 46 | 47 |
| | 5 | 29 | 30 | 31 | 32 | 34 | 35 | 36 | 37 | 38 | 40 | 41 | 42 | 43 | 44 | 46 | 47 |
| | 6 | 29 | 30 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 39 | 41 | 42 | 43 | 44 | 45 | 47 |
| | 7 | 28 | 30 | 31 | 32 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 | 43 | 44 | 45 | 46 |
| | 8 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 42 | 43 | 45 | 46 |
| | 9 | 28 | 29 | 30 | 31 | 33 | 34 | 35 | 36 | 37 | 38 | 40 | 41 | 42 | 43 | 44 | 45 |
| | 10 | 28 | 29 | 30 | 31 | 32 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 42 | 43 | 44 | 45 |
| | 11 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 44 | 45 |
| 11 | 0 | 27 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 42 | 43 | 44 |
| | 1 | 27 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 40 | 41 | 42 | 43 | 44 |
| | 2 | 27 | 28 | 29 | 30 | 31 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 42 | 43 | 44 |
| | 3 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 |
| | 4 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 | 42 | 43 |
| | 5 | 26 | 27 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 41 | 42 | 43 |
| | 6 | 26 | 27 | 28 | 29 | 30 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 |
| | 7 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 |
| | 8 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 | 42 |
| | 9 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 42 |
| | 10 | 25 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 |
| | 11 | 25 | 26 | 27 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 |

| | | III | | | | | | | IV | | | | | | | | |
|----|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12 | 0 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 37 | 38 | 39 | 40 | 41 |
| | 1 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 2 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 3 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 4 | 25 | 26 | 27 | 28 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 5 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 6 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 7 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 8 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 9 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 10 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 11 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 18 | 0 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| | 1 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 2 | 25 | 26 | 27 | 28 | 29 | 30 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 3 | 25 | 26 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 4 | 25 | 26 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 5 | 25 | 26 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 34 | 35 | 36 | 37 | 38 |
| | 6 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 7 | 25 | 26 | 27 | 28 | 29 | 30 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 8 | 25 | 26 | 27 | 28 | 28 | 29 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 9 | 25 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 10 | 25 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 31 | 32 | 33 | 34 | 34 | 35 | 36 | 37 |
| | 11 | 25 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 31 | 32 | 32 | 33 | 34 | 35 | 36 | 37 |
| 14 | 0 | 25 | 26 | 27 | 28 | 29 | 30 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 1 | 25 | 26 | 27 | 28 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 2 | 25 | 26 | 27 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 3 | 25 | 26 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 4 | 25 | 26 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |
| | 5 | 25 | 26 | 26 | 27 | 28 | 29 | 30 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 6 | 25 | 26 | 27 | 28 | 29 | 30 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 7 | 25 | 26 | 27 | 27 | 28 | 29 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 8 | 25 | 26 | 27 | 27 | 28 | 29 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| | 9 | 25 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| | 10 | 25 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 36 |
| | 11 | 25 | 25 | 26 | 27 | 28 | 29 | 29 | 29 | 30 | 30 | 31 | 31 | 32 | 33 | 34 | 35 |
| 15 | 0 | 25 | 26 | 27 | 28 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |

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| | | V | | | | | | | | VI | | | | | | | |
|-----|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | 150 | | | | | | | | | | | | | | | |
| 5 | | 146 | 150 | | | | | | | | | | | | | | |
| 6 | | 143 | 147 | 150 | | | | | | | | | | | | | |
| 3 7 | | 140 | 143 | 147 | 150 | | | | | | | | | | | | |
| 8 | | 137 | 140 | 143 | 147 | 150 | | | | | | | | | | | |
| 9 | | 133 | 137 | 140 | 144 | 147 | 150 | | | | | | | | | | |
| 10 | | 131 | 134 | 137 | 141 | 144 | 147 | 150 | | | | | | | | | |
| 11 | | 128 | 131 | 134 | 138 | 141 | 144 | 147 | 150 | | | | | | | | |
| 0 | | 125 | 128 | 131 | 135 | 138 | 141 | 144 | 147 | 150 | | | | | | | |
| 1 | | 123 | 126 | 129 | 132 | 135 | 138 | 141 | 144 | 147 | 150 | | | | | | |
| 2 | | 120 | 123 | 126 | 129 | 132 | 135 | 138 | 141 | 144 | 147 | 150 | | | | | |
| 3 | | 118 | 121 | 124 | 127 | 129 | 132 | 135 | 138 | 141 | 144 | 147 | 150 | | | | |
| 4 | | 116 | 119 | 121 | 124 | 127 | 130 | 133 | 136 | 139 | 141 | 144 | 147 | 150 | | | |
| 5 | | 113 | 116 | 119 | 122 | 125 | 127 | 130 | 133 | 136 | 139 | 141 | 144 | 147 | 150 | | |
| 6 | | 111 | 114 | 117 | 120 | 122 | 125 | 128 | 131 | 133 | 136 | 139 | 142 | 144 | 147 | 150 | |
| 7 | | 109 | 112 | 115 | 118 | 120 | 123 | 126 | 128 | 131 | 134 | 137 | 139 | 142 | 145 | 147 | 150 |
| 8 | | 107 | 110 | 113 | 115 | 118 | 121 | 123 | 126 | 129 | 132 | 134 | 137 | 140 | 142 | 145 | 148 |
| 9 | | 105 | 108 | 111 | 113 | 116 | 119 | 121 | 124 | 126 | 129 | 132 | 134 | 137 | 140 | 142 | 145 |
| 10 | | 104 | 106 | 109 | 111 | 114 | 117 | 119 | 122 | 124 | 127 | 129 | 132 | 135 | 137 | 140 | 142 |
| 11 | | 102 | 105 | 107 | 110 | 112 | 115 | 117 | 120 | 122 | 125 | 127 | 130 | 132 | 135 | 138 | 140 |
| 0 | | 100 | 103 | 105 | 108 | 110 | 113 | 115 | 118 | 120 | 123 | 125 | 128 | 130 | 133 | 135 | 138 |
| 1 | | 98 | 101 | 103 | 106 | 108 | 111 | 113 | 116 | 118 | 121 | 123 | 126 | 128 | 131 | 133 | 135 |
| 2 | | 97 | 99 | 102 | 104 | 106 | 109 | 111 | 114 | 116 | 119 | 121 | 123 | 126 | 128 | 131 | 133 |
| 3 | | 95 | 98 | 100 | 103 | 105 | 107 | 110 | 112 | 114 | 117 | 119 | 122 | 124 | 126 | 129 | 131 |
| 4 | | 94 | 96 | 99 | 101 | 103 | 106 | 108 | 110 | 113 | 115 | 117 | 120 | 122 | 124 | 127 | 129 |
| 5 | | 92 | 95 | 97 | 99 | 102 | 104 | 106 | 109 | 111 | 113 | 115 | 118 | 120 | 122 | 125 | 127 |
| 6 | | 91 | 93 | 96 | 98 | 100 | 102 | 105 | 107 | 109 | 112 | 114 | 116 | 118 | 121 | 123 | 125 |
| 7 | | 90 | 92 | 94 | 96 | 99 | 101 | 103 | 105 | 108 | 110 | 112 | 114 | 117 | 119 | 121 | 123 |
| 8 | | 88 | 91 | 93 | 95 | 97 | 100 | 102 | 104 | 106 | 108 | 110 | 113 | 115 | 117 | 119 | 122 |
| 9 | | 87 | 89 | 91 | 94 | 96 | 98 | 100 | 102 | 104 | 107 | 109 | 111 | 113 | 115 | 117 | 120 |
| 10 | | 86 | 88 | 90 | 92 | 94 | 97 | 99 | 101 | 103 | 105 | 107 | 109 | 112 | 114 | 116 | 118 |
| 11 | | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 100 | 102 | 104 | 106 | 108 | 110 | 112 | 114 | 116 |

| V | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|---------|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | | |
| 0 | 83 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 108 111 |
| 1 | 82 | 84 | 86 | 89 | 91 | 93 | 95 | 97 | 99 | 101 | 103 | 105 | 107 109 |
| 2 | 81 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 99 | 101 | 103 | 105 107 |
| 3 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 106 |
| 4 | 79 | 81 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 99 | 101 | 103 105 |
| 5 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 104 |
| 6 | 77 | 79 | 81 | 83 | 85 | 87 | 89 | 91 | 92 | 94 | 96 | 98 | 100 102 |
| 7 | 76 | 78 | 80 | 82 | 84 | 86 | 87 | 89 | 91 | 93 | 95 | 97 | 99 101 |
| 8 | 75 | 77 | 79 | 81 | 83 | 85 | 86 | 88 | 90 | 92 | 94 | 96 | 98 100 |
| 9 | 74 | 76 | 78 | 80 | 82 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 96 98 |
| 10 | 73 | 75 | 77 | 79 | 81 | 82 | 84 | 86 | 88 | 90 | 92 | 93 | 95 97 |
| 11 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 85 | 87 | 89 | 91 | 92 | 94 96 |
| 0 | 71 | 73 | 75 | 77 | 79 | 80 | 82 | 84 | 86 | 88 | 89 | 91 | 93 95 |
| 1 | 71 | 73 | 74 | 76 | 78 | 80 | 81 | 83 | 85 | 87 | 88 | 90 | 92 94 |
| 2 | 70 | 72 | 73 | 75 | 77 | 79 | 80 | 82 | 84 | 86 | 87 | 89 | 91 93 |
| 3 | 69 | 71 | 72 | 74 | 76 | 78 | 79 | 81 | 83 | 85 | 86 | 88 | 90 92 |
| 4 | 68 | 70 | 72 | 73 | 75 | 77 | 79 | 80 | 82 | 84 | 85 | 87 | 89 91 |
| 5 | 67 | 69 | 71 | 73 | 74 | 76 | 78 | 79 | 81 | 83 | 84 | 86 | 88 89 |
| 6 | 67 | 68 | 70 | 72 | 73 | 75 | 77 | 78 | 80 | 82 | 83 | 85 | 87 88 |
| 7 | 66 | 68 | 69 | 71 | 73 | 74 | 76 | 78 | 79 | 81 | 83 | 84 | 86 88 |
| 8 | 65 | 67 | 69 | 70 | 72 | 74 | 75 | 77 | 78 | 80 | 82 | 83 | 85 87 |
| 9 | 65 | 66 | 68 | 69 | 71 | 73 | 74 | 76 | 77 | 79 | 81 | 82 | 84 86 |
| 10 | 64 | 66 | 67 | 69 | 70 | 72 | 73 | 75 | 77 | 78 | 80 | 82 | 83 85 |
| 11 | 63 | 65 | 66 | 68 | 70 | 71 | 73 | 74 | 76 | 78 | 79 | 81 | 82 84 |
| 0 | 63 | 64 | 66 | 67 | 69 | 70 | 72 | 74 | 75 | 77 | 78 | 80 | 81 83 |
| 1 | 62 | 64 | 65 | 67 | 68 | 70 | 71 | 73 | 74 | 76 | 77 | 79 | 80 82 |
| 2 | 61 | 63 | 64 | 66 | 67 | 69 | 70 | 72 | 73 | 75 | 77 | 78 | 80 81 |
| 3 | 61 | 62 | 64 | 65 | 67 | 68 | 70 | 71 | 73 | 74 | 76 | 77 | 79 80 |
| 4 | 60 | 62 | 63 | 65 | 66 | 68 | 69 | 71 | 72 | 74 | 75 | 77 | 78 80 |
| 5 | 59 | 61 | 62 | 64 | 65 | 67 | 68 | 70 | 71 | 73 | 74 | 76 | 77 79 |
| 6 | 59 | 60 | 62 | 63 | 65 | 66 | 68 | 69 | 71 | 72 | 74 | 75 | 77 78 |
| 7 | 58 | 60 | 61 | 63 | 64 | 66 | 67 | 69 | 70 | 71 | 73 | 74 | 76 77 |
| 8 | 58 | 59 | 61 | 62 | 64 | 65 | 66 | 68 | 69 | 71 | 72 | 74 | 76 77 |
| 9 | 57 | 59 | 60 | 62 | 63 | 64 | 66 | 67 | 69 | 70 | 71 | 73 | 74 76 |
| 10 | 57 | 58 | 60 | 61 | 62 | 64 | 65 | 67 | 68 | 69 | 71 | 72 | 74 75 |
| 11 | 56 | 58 | 59 | 60 | 62 | 63 | 65 | 66 | 67 | 69 | 70 | 72 | 73 74 |

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| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9 | 0 | 56 | 57 | 58 | 60 | 61 | 63 | 64 | 65 | 67 | 68 | 69 | 71 | 72 | 74 | 75 | 76 |
| | 1 | 55 | 56 | 58 | 59 | 60 | 62 | 63 | 65 | 66 | 68 | 69 | 70 | 72 | 73 | 74 | 76 |
| | 2 | 55 | 56 | 57 | 59 | 60 | 61 | 63 | 64 | 65 | 67 | 68 | 70 | 71 | 73 | 74 | 75 |
| | 3 | 54 | 55 | 57 | 58 | 59 | 61 | 62 | 64 | 65 | 66 | 68 | 69 | 70 | 72 | 73 | 74 |
| | 4 | 54 | 55 | 56 | 58 | 59 | 60 | 62 | 63 | 64 | 66 | 67 | 68 | 70 | 71 | 72 | 74 |
| | 5 | 53 | 54 | 56 | 57 | 58 | 60 | 61 | 62 | 64 | 65 | 66 | 68 | 69 | 70 | 72 | 73 |
| | 6 | 53 | 54 | 55 | 57 | 58 | 59 | 61 | 62 | 63 | 65 | 66 | 67 | 68 | 70 | 71 | 72 |
| | 7 | 52 | 53 | 55 | 56 | 57 | 59 | 60 | 61 | 63 | 64 | 65 | 67 | 68 | 69 | 71 | 72 |
| | 8 | 52 | 53 | 54 | 56 | 57 | 58 | 60 | 61 | 62 | 63 | 65 | 66 | 67 | 69 | 70 | 71 |
| | 9 | 51 | 53 | 54 | 55 | 56 | 58 | 59 | 60 | 62 | 63 | 64 | 65 | 67 | 68 | 69 | 71 |
| | 10 | 51 | 52 | 53 | 55 | 56 | 57 | 59 | 60 | 61 | 62 | 64 | 65 | 66 | 67 | 68 | 70 |
| | 11 | 51 | 52 | 53 | 54 | 56 | 57 | 58 | 59 | 61 | 62 | 63 | 64 | 66 | 67 | 68 | 70 |
| 10 | 0 | 50 | 51 | 53 | 54 | 55 | 56 | 58 | 59 | 60 | 61 | 63 | 64 | 65 | 66 | 68 | 69 |
| | 1 | 50 | 51 | 52 | 53 | 55 | 56 | 57 | 58 | 60 | 61 | 62 | 63 | 65 | 66 | 67 | 68 |
| | 2 | 49 | 50 | 52 | 53 | 54 | 55 | 57 | 58 | 59 | 60 | 62 | 63 | 64 | 65 | 66 | 68 |
| | 3 | 49 | 50 | 51 | 53 | 54 | 55 | 56 | 57 | 59 | 60 | 61 | 62 | 63 | 65 | 66 | 67 |
| | 4 | 48 | 50 | 51 | 52 | 53 | 55 | 56 | 57 | 58 | 59 | 61 | 62 | 63 | 64 | 65 | 67 |
| | 5 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 58 | 59 | 60 | 61 | 62 | 64 | 65 | 66 |
| | 6 | 48 | 49 | 50 | 51 | 52 | 54 | 55 | 56 | 57 | 58 | 60 | 61 | 62 | 63 | 64 | 66 |
| | 7 | 47 | 49 | 50 | 51 | 52 | 53 | 54 | 56 | 57 | 58 | 59 | 60 | 61 | 63 | 64 | 65 |
| | 8 | 47 | 48 | 49 | 51 | 52 | 53 | 54 | 55 | 56 | 58 | 59 | 60 | 61 | 62 | 63 | 65 |
| | 9 | 47 | 48 | 49 | 50 | 51 | 52 | 54 | 55 | 56 | 57 | 58 | 59 | 61 | 62 | 63 | 64 |
| | 10 | 46 | 47 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 57 | 58 | 59 | 60 | 61 | 62 | 64 |
| | 11 | 46 | 47 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 57 | 59 | 60 | 61 | 62 | 63 |
| 11 | 0 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 63 |
| | 1 | 45 | 46 | 47 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 58 | 59 | 60 | 61 | 62 |
| | 2 | 45 | 46 | 47 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 61 | 62 |
| | 3 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 55 | 56 | 57 | 58 | 59 | 60 | 61 |
| | 4 | 44 | 45 | 46 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 59 | 60 | 61 |
| | 5 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| | 6 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 56 | 57 | 58 | 59 | 60 |
| | 7 | 43 | 44 | 45 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| | 8 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |
| | 9 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 58 | 59 |
| | 10 | 42 | 43 | 44 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |
| | 11 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 57 | 58 |

| V | | | | | | | | | | | | VI | | | | | | | | | | | |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|--|--|--|--|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | | | | | | |
| 0 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | | | | | | | |
| 1 | 41 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | | | | | | | |
| 2 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 55 | 56 | 57 | | | | | | | |
| 3 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | | | | | | | |
| 4 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | | | | | | | |
| 5 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | | | | | | | |
| 12 6 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | | | | | | | |
| 7 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | | | | | | | |
| 8 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | | | | | | | |
| 9 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | | | | | | | |
| 10 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | | | | | | | |
| 11 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 48 | 49 | 50 | 51 | 52 | 53 | | | | | | | |
| 0 | 39 | 40 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | | | | | | | |
| 1 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | | | | | | | |
| 2 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 48 | 49 | 50 | 51 | 52 | | | | | | | |
| 3 | 38 | 39 | 40 | 41 | 42 | 43 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | | | | | | | |
| 4 | 38 | 39 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | | | | | | | |
| 5 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 48 | 49 | 50 | 51 | | | | | | | |
| 13 6 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | | | | | | | |
| 7 | 37 | 38 | 39 | 40 | 41 | 42 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | | | | | | | |
| 8 | 37 | 38 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 49 | 50 | | | | | | | |
| 9 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 46 | 47 | 48 | 49 | 50 | | | | | | | |
| 10 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | | | | | | | |
| 11 | 36 | 37 | 38 | 39 | 40 | 41 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | | | | | | | |
| 0 | 36 | 37 | 38 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 46 | 47 | 48 | 49 | | | | | | | |
| 1 | 36 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 44 | 45 | 46 | 47 | 48 | 49 | | | | | | | |
| 2 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | | | | | | | |
| 3 | 35 | 36 | 37 | 38 | 39 | 40 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 47 | 48 | | | | | | | |
| 4 | 35 | 36 | 37 | 38 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 45 | 46 | 47 | 48 | | | | | | | |
| 5 | 35 | 36 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 43 | 44 | 45 | 46 | 47 | 48 | | | | | | | |
| 14 6 | 35 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | | | | | | | |
| 7 | 34 | 35 | 36 | 37 | 38 | 39 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 46 | 47 | | | | | | | |
| 8 | 34 | 35 | 36 | 37 | 38 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 44 | 45 | 46 | 47 | | | | | | | |
| 9 | 34 | 35 | 36 | 37 | 37 | 38 | 39 | 40 | 41 | 42 | 42 | 43 | 44 | 45 | 46 | 47 | | | | | | | |
| 10 | 34 | 35 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 41 | 42 | 43 | 44 | 45 | 46 | 46 | | | | | | | |
| 11 | 34 | 34 | 35 | 36 | 37 | 38 | 39 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 45 | 46 | | | | | | | |
| 15 0 | 33 | 34 | 35 | 36 | 37 | 38 | 38 | 39 | 40 | 41 | 42 | 43 | 43 | 44 | 45 | 46 | | | | | | | |

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| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 150 | | | | | | | | | | | | | | | |
| 4 9 | 147 | 150 | | | | | | | | | | | | | | |
| 10 | 145 | 148 | 150 | | | | | | | | | | | | | |
| 11 | 143 | 145 | 148 | 150 | | | | | | | | | | | | |
| 0 | 140 | 143 | 145 | 148 | 150 | | | | | | | | | | | |
| 1 | 138 | 140 | 143 | 145 | 148 | 150 | | | | | | | | | | |
| 2 | 135 | 138 | 140 | 143 | 145 | 148 | 150 | | | | | | | | | |
| 3 | 133 | 136 | 138 | 141 | 143 | 145 | 148 | 150 | | | | | | | | |
| 4 | 131 | 134 | 136 | 139 | 141 | 143 | 145 | 148 | 150 | | | | | | | |
| 5 | 129 | 132 | 134 | 136 | 138 | 141 | 143 | 145 | 148 | 150 | | | | | | |
| 5 6 | 127 | 130 | 132 | 134 | 136 | 139 | 141 | 143 | 146 | 148 | 150 | | | | | |
| 7 | 125 | 128 | 130 | 132 | 134 | 137 | 139 | 141 | 143 | 146 | 148 | 150 | | | | |
| 8 | 124 | 126 | 128 | 130 | 133 | 135 | 137 | 139 | 141 | 144 | 146 | 148 | 150 | | | |
| 9 | 122 | 124 | 126 | 128 | 130 | 133 | 135 | 137 | 139 | 141 | 144 | 146 | 148 | 150 | | |
| 10 | 120 | 122 | 124 | 127 | 129 | 131 | 133 | 135 | 137 | 140 | 142 | 144 | 146 | 148 | 150 | |
| 11 | 118 | 121 | 123 | 125 | 127 | 129 | 131 | 133 | 135 | 138 | 140 | 142 | 144 | 146 | 148 | 150 |
| 0 | 117 | 119 | 121 | 123 | 125 | 127 | 129 | 131 | 133 | 136 | 138 | 140 | 142 | 144 | 146 | 148 |
| 1 | 115 | 117 | 119 | 121 | 123 | 126 | 128 | 130 | 132 | 134 | 136 | 138 | 140 | 142 | 144 | 146 |
| 2 | 114 | 116 | 118 | 120 | 122 | 124 | 126 | 128 | 130 | 132 | 134 | 136 | 138 | 140 | 142 | 144 |
| 3 | 112 | 114 | 116 | 118 | 120 | 122 | 124 | 126 | 128 | 130 | 132 | 134 | 136 | 138 | 140 | 142 |
| 4 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 126 | 128 | 130 | 132 | 134 | 136 | 138 | 140 |
| 5 | 109 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 129 | 131 | 132 | 134 | 136 | 138 |
| 6 6 | 108 | 110 | 112 | 114 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 129 | 131 | 133 | 135 | 137 |
| 7 | 106 | 108 | 110 | 112 | 114 | 116 | 118 | 120 | 122 | 124 | 125 | 127 | 129 | 131 | 133 | 135 |
| 8 | 105 | 107 | 109 | 111 | 113 | 115 | 116 | 118 | 120 | 122 | 124 | 126 | 128 | 130 | 131 | 133 |
| 9 | 104 | 106 | 107 | 109 | 111 | 113 | 115 | 117 | 119 | 120 | 122 | 124 | 126 | 128 | 130 | 132 |
| 10 | 103 | 104 | 106 | 108 | 110 | 112 | 114 | 115 | 117 | 119 | 121 | 123 | 125 | 126 | 128 | 130 |
| 11 | 102 | 103 | 105 | 107 | 109 | 110 | 112 | 114 | 116 | 118 | 119 | 121 | 123 | 125 | 127 | 129 |
| 0 | 100 | 102 | 104 | 105 | 107 | 109 | 111 | 112 | 114 | 116 | 118 | 120 | 121 | 123 | 125 | 127 |
| 1 | 99 | 101 | 102 | 104 | 106 | 108 | 109 | 111 | 113 | 115 | 117 | 118 | 120 | 122 | 124 | 125 |
| 2 | 98 | 99 | 101 | 103 | 105 | 106 | 108 | 110 | 112 | 113 | 115 | 117 | 119 | 120 | 122 | 124 |
| 3 | 97 | 99 | 100 | 102 | 103 | 105 | 107 | 109 | 110 | 112 | 114 | 116 | 117 | 119 | 121 | 123 |
| 4 | 96 | 97 | 99 | 101 | 102 | 104 | 106 | 108 | 109 | 111 | 113 | 114 | 116 | 118 | 119 | 121 |
| 5 | 94 | 96 | 98 | 100 | 101 | 103 | 104 | 106 | 108 | 110 | 111 | 113 | 115 | 116 | 118 | 120 |
| 7 6 | 93 | 95 | 97 | 98 | 100 | 102 | 103 | 105 | 107 | 108 | 110 | 112 | 113 | 115 | 117 | 118 |
| 7 | 92 | 94 | 96 | 97 | 99 | 101 | 102 | 104 | 106 | 107 | 109 | 111 | 112 | 114 | 115 | 117 |
| 8 | 91 | 93 | 95 | 96 | 98 | 100 | 101 | 103 | 104 | 106 | 108 | 109 | 111 | 113 | 114 | 116 |
| 9 | 90 | 92 | 94 | 95 | 97 | 99 | 100 | 102 | 103 | 105 | 107 | 108 | 110 | 111 | 113 | 115 |
| 10 | 89 | 91 | 93 | 94 | 96 | 98 | 99 | 101 | 102 | 104 | 105 | 107 | 108 | 110 | 112 | 113 |
| 11 | 89 | 90 | 92 | 93 | 95 | 97 | 98 | 100 | 101 | 103 | 104 | 106 | 108 | 109 | 111 | 112 |

| | | VII | | | | | | | | VIII | | | | | | | |
|----|----|-----|----|----|----|----|----|----|----|------|-----|-----|-----|-----|-----|-----|-----|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 0 | 88 | 89 | 91 | 92 | 94 | 95 | 97 | 99 | 100 | 102 | 103 | 105 | 106 | 108 | 109 | 111 |
| | 1 | 87 | 88 | 90 | 91 | 93 | 94 | 96 | 98 | 99 | 101 | 102 | 104 | 105 | 107 | 108 | 110 |
| | 2 | 86 | 87 | 89 | 90 | 92 | 93 | 95 | 97 | 98 | 100 | 101 | 103 | 104 | 106 | 107 | 109 |
| | 3 | 85 | 86 | 88 | 90 | 91 | 93 | 94 | 96 | 97 | 99 | 100 | 102 | 103 | 105 | 106 | 108 |
| | 4 | 84 | 86 | 87 | 89 | 90 | 92 | 93 | 95 | 96 | 98 | 99 | 101 | 102 | 104 | 105 | 107 |
| | 5 | 83 | 85 | 86 | 88 | 89 | 91 | 92 | 94 | 95 | 97 | 98 | 100 | 101 | 103 | 104 | 106 |
| | 6 | 82 | 84 | 85 | 87 | 88 | 90 | 91 | 93 | 94 | 96 | 97 | 99 | 100 | 102 | 103 | 104 |
| | 7 | 82 | 83 | 85 | 86 | 87 | 89 | 90 | 92 | 93 | 95 | 96 | 98 | 99 | 101 | 102 | 104 |
| | 8 | 81 | 82 | 84 | 85 | 87 | 88 | 90 | 91 | 92 | 94 | 95 | 97 | 98 | 100 | 101 | 103 |
| | 9 | 80 | 82 | 83 | 84 | 86 | 87 | 89 | 90 | 91 | 93 | 94 | 96 | 97 | 99 | 100 | 102 |
| 9 | 10 | 79 | 81 | 82 | 84 | 85 | 86 | 88 | 89 | 91 | 92 | 93 | 95 | 96 | 98 | 99 | 101 |
| | 11 | 79 | 80 | 81 | 83 | 84 | 86 | 87 | 88 | 90 | 91 | 93 | 94 | 95 | 97 | 98 | 100 |
| | 0 | 78 | 79 | 81 | 82 | 83 | 85 | 86 | 88 | 89 | 90 | 92 | 93 | 94 | 96 | 97 | 99 |
| | 1 | 77 | 79 | 80 | 81 | 83 | 84 | 85 | 87 | 88 | 90 | 91 | 92 | 94 | 95 | 96 | 98 |
| | 2 | 76 | 78 | 79 | 81 | 82 | 83 | 85 | 86 | 87 | 89 | 90 | 91 | 93 | 94 | 95 | 97 |
| | 3 | 76 | 77 | 78 | 80 | 81 | 83 | 84 | 85 | 86 | 88 | 89 | 90 | 92 | 93 | 95 | 96 |
| | 4 | 75 | 76 | 78 | 79 | 80 | 82 | 83 | 84 | 86 | 87 | 88 | 90 | 91 | 92 | 94 | 95 |
| | 5 | 74 | 76 | 77 | 78 | 80 | 81 | 82 | 84 | 85 | 86 | 88 | 89 | 90 | 92 | 93 | 94 |
| | 6 | 74 | 75 | 76 | 78 | 79 | 80 | 82 | 83 | 84 | 85 | 87 | 88 | 89 | 91 | 92 | 93 |
| | 7 | 73 | 74 | 76 | 77 | 78 | 80 | 81 | 82 | 83 | 85 | 86 | 87 | 88 | 90 | 91 | 92 |
| 10 | 8 | 73 | 74 | 75 | 76 | 78 | 79 | 80 | 82 | 83 | 84 | 85 | 87 | 88 | 89 | 90 | 92 |
| | 9 | 72 | 73 | 74 | 76 | 77 | 78 | 79 | 81 | 82 | 83 | 85 | 86 | 87 | 89 | 90 | 91 |
| | 10 | 71 | 72 | 74 | 75 | 76 | 78 | 79 | 80 | 81 | 83 | 84 | 85 | 87 | 88 | 89 | 90 |
| | 11 | 71 | 72 | 73 | 75 | 76 | 77 | 78 | 80 | 81 | 82 | 83 | 85 | 86 | 87 | 88 | 90 |
| | 0 | 70 | 71 | 73 | 74 | 75 | 76 | 78 | 79 | 80 | 81 | 83 | 84 | 85 | 86 | 88 | 89 |
| | 1 | 69 | 71 | 72 | 73 | 74 | 76 | 77 | 78 | 79 | 81 | 82 | 83 | 84 | 86 | 87 | 88 |
| | 2 | 69 | 70 | 71 | 73 | 74 | 75 | 76 | 78 | 79 | 80 | 81 | 82 | 84 | 85 | 86 | 87 |
| | 3 | 68 | 70 | 71 | 72 | 73 | 74 | 76 | 77 | 78 | 79 | 81 | 82 | 83 | 84 | 85 | 87 |
| | 4 | 68 | 69 | 70 | 71 | 73 | 74 | 75 | 76 | 77 | 79 | 80 | 81 | 82 | 84 | 85 | 86 |
| | 5 | 67 | 68 | 70 | 71 | 72 | 73 | 74 | 76 | 77 | 78 | 79 | 80 | 82 | 83 | 84 | 85 |
| 11 | 6 | 67 | 68 | 69 | 70 | 71 | 73 | 74 | 75 | 76 | 77 | 79 | 80 | 81 | 82 | 83 | 85 |
| | 7 | 66 | 67 | 69 | 70 | 71 | 72 | 73 | 75 | 76 | 77 | 78 | 79 | 80 | 82 | 83 | 84 |
| | 8 | 66 | 67 | 68 | 69 | 70 | 72 | 73 | 74 | 75 | 76 | 77 | 79 | 80 | 81 | 82 | 83 |
| | 9 | 65 | 66 | 67 | 69 | 70 | 71 | 72 | 73 | 74 | 76 | 77 | 78 | 79 | 80 | 81 | 83 |
| | 10 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 79 | 80 | 81 | 82 |
| | 11 | 64 | 65 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 75 | 76 | 77 | 78 | 79 | 80 | 81 |

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| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11 | 0 | 64 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 79 | 80 | 81 |
| | 1 | 63 | 64 | 65 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 75 | 76 | 77 | 78 | 79 | 80 |
| | 2 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
| | 3 | 62 | 63 | 64 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 75 | 76 | 77 | 78 | 79 |
| | 4 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 |
| | 5 | 61 | 62 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 76 | 77 | 78 |
| | 6 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 |
| | 7 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 75 | 76 | 77 |
| | 8 | 60 | 61 | 62 | 63 | 64 | 65 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 |
| | 9 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 74 | 75 | 76 |
| | 10 | 59 | 60 | 61 | 62 | 63 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
| | 11 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 73 | 74 | 75 |
| 12 | 0 | 58 | 59 | 60 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 |
| | 1 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 74 |
| | 2 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 |
| | 3 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 73 |
| | 4 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 |
| | 5 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 66 | 67 | 68 | 69 | 70 | 71 | 72 |
| | 6 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
| | 7 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
| | 8 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| | 9 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 |
| | 10 | 55 | 56 | 57 | 58 | 59 | 60 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
| | 11 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
| 13 | 0 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 65 | 66 | 67 | 68 |
| | 1 | 54 | 55 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 |
| | 2 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 66 | 67 |
| | 3 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 |
| | 4 | 53 | 54 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 |
| | 5 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 62 | 63 | 64 | 65 | 66 |
| | 6 | 52 | 53 | 54 | 55 | 56 | 57 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 |
| | 7 | 52 | 53 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 64 | 65 |
| | 8 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 60 | 61 | 62 | 63 | 64 | 65 |
| | 9 | 51 | 52 | 53 | 54 | 55 | 56 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 |
| | 10 | 51 | 52 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 62 | 63 | 64 |
| | 11 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 59 | 60 | 61 | 62 | 63 | 64 |

| VII | | | | | | | | | | | | | | | | |
|-----|----|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | VIII | | | | | | | |
| | | | | | | | | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 50 | 51 | 52 | 53 | 54 | 55 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 63 |
| 1 | 50 | 51 | 52 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 60 | 61 | 62 | 63 |
| 2 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |
| 3 | 49 | 50 | 51 | 52 | 53 | 54 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 61 | 62 |
| 4 | 49 | 50 | 51 | 52 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 59 | 60 | 61 | 62 |
| 5 | 49 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 56 | 57 | 58 | 59 | 60 | 61 | 62 |
| 14 | 6 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 |
| | 7 | 48 | 49 | 50 | 51 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 58 | 59 | 60 |
| | 8 | 48 | 49 | 50 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 |
| 9 | 48 | 48 | 49 | 50 | 51 | 52 | 53 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 59 | 60 |
| 10 | 47 | 48 | 49 | 50 | 51 | 52 | 52 | 53 | 54 | 55 | 56 | 57 | 57 | 58 | 59 | 60 |
| 11 | 47 | 48 | 49 | 50 | 50 | 51 | 52 | 53 | 54 | 55 | 55 | 56 | 57 | 58 | 59 | 60 |
| 15 | 0 | 47 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 53 | 54 | 55 | 56 | 57 | 58 | 59 |

| IX | | | | | | | | | | X | | | | | | | | | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 150 | | | | | | | | | | | | | | | | | | |
| 1 | 148 | 150 | | | | | | | | | | | | | | | | | |
| 2 | 146 | 148 | 150 | | | | | | | | | | | | | | | | |
| 3 | 144 | 146 | 148 | 150 | | | | | | | | | | | | | | | |
| 4 | 142 | 144 | 146 | 148 | 150 | | | | | | | | | | | | | | |
| 5 | 140 | 142 | 144 | 146 | 148 | 150 | | | | | | | | | | | | | |
| 6 | 139 | 141 | 142 | 144 | 146 | 148 | 150 | | | | | | | | | | | | |
| 7 | 137 | 139 | 141 | 143 | 144 | 146 | 148 | 150 | | | | | | | | | | | |
| 8 | 135 | 137 | 139 | 141 | 143 | 145 | 146 | 148 | 150 | | | | | | | | | | |
| 9 | 133 | 135 | 137 | 139 | 141 | 143 | 144 | 146 | 148 | 150 | | | | | | | | | |
| 10 | 132 | 134 | 135 | 137 | 139 | 141 | 143 | 145 | 146 | 148 | 150 | | | | | | | | |
| 11 | 130 | 132 | 134 | 136 | 138 | 139 | 141 | 143 | 145 | 147 | 148 | 150 | | | | | | | |
| 0 | 129 | 130 | 132 | 134 | 136 | 138 | 139 | 141 | 143 | 145 | 146 | 148 | 150 | | | | | | |
| 1 | 127 | 129 | 131 | 133 | 134 | 136 | 138 | 140 | 141 | 143 | 145 | 147 | 148 | 150 | | | | | |
| 2 | 126 | 127 | 129 | 131 | 133 | 134 | 136 | 138 | 140 | 141 | 143 | 145 | 146 | 148 | 150 | | | | |
| 3 | 124 | 126 | 128 | 129 | 131 | 133 | 135 | 136 | 138 | 140 | 142 | 144 | 145 | 147 | 148 | 150 | | | |
| 4 | 123 | 125 | 126 | 128 | 130 | 131 | 133 | 135 | 136 | 138 | 140 | 142 | 143 | 145 | 147 | 148 | 150 | | |
| 5 | 121 | 123 | 125 | 126 | 128 | 130 | 131 | 133 | 135 | 137 | 138 | 140 | 142 | 143 | 145 | 147 | 148 | 150 | |
| 6 | 120 | 122 | 123 | 125 | 127 | 128 | 130 | 132 | 133 | 135 | 137 | 138 | 140 | 142 | 143 | 145 | 147 | 148 | 150 |
| 7 | 119 | 120 | 122 | 124 | 125 | 127 | 129 | 130 | 132 | 134 | 135 | 137 | 139 | 140 | 142 | 144 | 147 | 148 | 150 |
| 8 | 118 | 119 | 121 | 123 | 124 | 126 | 127 | 129 | 131 | 132 | 134 | 136 | 137 | 139 | 140 | 142 | 144 | 147 | 148 |
| 9 | 116 | 118 | 119 | 121 | 123 | 124 | 126 | 128 | 129 | 131 | 132 | 134 | 136 | 137 | 139 | 140 | 142 | 144 | 147 |
| 10 | 115 | 117 | 118 | 120 | 121 | 123 | 125 | 126 | 128 | 129 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 142 | 144 |
| 11 | 114 | 115 | 117 | 119 | 120 | 122 | 123 | 125 | 126 | 128 | 130 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 142 |

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| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 0 | 113 | 114 | 116 | 117 | 119 | 120 | 122 | 124 | 125 | 127 | 128 | 130 | 131 | 133 | 134 | 136 |
| | 1 | 111 | 113 | 115 | 116 | 118 | 119 | 121 | 122 | 124 | 125 | 127 | 128 | 130 | 132 | 133 | 135 |
| | 2 | 110 | 112 | 113 | 115 | 116 | 118 | 119 | 121 | 122 | 124 | 125 | 127 | 129 | 130 | 132 | 133 |
| | 3 | 109 | 111 | 112 | 114 | 115 | 117 | 118 | 120 | 121 | 123 | 124 | 126 | 127 | 129 | 130 | 132 |
| | 4 | 108 | 110 | 111 | 113 | 114 | 116 | 117 | 119 | 120 | 122 | 123 | 125 | 126 | 128 | 129 | 131 |
| | 5 | 107 | 108 | 110 | 111 | 113 | 114 | 116 | 117 | 119 | 120 | 122 | 123 | 125 | 126 | 128 | 129 |
| | 6 | 106 | 107 | 109 | 110 | 112 | 113 | 115 | 116 | 118 | 119 | 121 | 122 | 124 | 125 | 127 | 128 |
| | 7 | 105 | 106 | 108 | 109 | 111 | 112 | 114 | 115 | 117 | 118 | 120 | 121 | 122 | 124 | 125 | 127 |
| | 8 | 104 | 105 | 107 | 108 | 110 | 111 | 113 | 114 | 116 | 117 | 118 | 120 | 121 | 123 | 124 | 126 |
| | 9 | 103 | 104 | 106 | 107 | 109 | 110 | 111 | 113 | 114 | 116 | 117 | 119 | 120 | 122 | 123 | 124 |
| | 10 | 102 | 103 | 105 | 106 | 108 | 109 | 110 | 112 | 113 | 115 | 116 | 118 | 119 | 120 | 122 | 123 |
| | 11 | 101 | 103 | 104 | 105 | 107 | 108 | 109 | 111 | 112 | 114 | 115 | 117 | 118 | 119 | 121 | 122 |
| 9 | 0 | 100 | 101 | 103 | 104 | 106 | 107 | 108 | 110 | 111 | 113 | 114 | 115 | 117 | 118 | 119 | 121 |
| | 1 | 99 | 101 | 102 | 103 | 105 | 106 | 107 | 109 | 110 | 111 | 113 | 114 | 116 | 117 | 118 | 119 |
| | 2 | 98 | 100 | 101 | 102 | 104 | 105 | 106 | 108 | 109 | 110 | 112 | 113 | 115 | 116 | 117 | 119 |
| | 3 | 97 | 99 | 100 | 101 | 103 | 104 | 105 | 107 | 108 | 110 | 111 | 112 | 113 | 115 | 116 | 118 |
| | 4 | 96 | 98 | 99 | 100 | 102 | 103 | 105 | 106 | 107 | 108 | 110 | 111 | 112 | 114 | 115 | 117 |
| | 5 | 96 | 97 | 98 | 100 | 101 | 102 | 104 | 105 | 106 | 107 | 109 | 110 | 111 | 113 | 114 | 115 |
| | 6 | 95 | 96 | 97 | 99 | 100 | 101 | 103 | 104 | 105 | 106 | 108 | 109 | 110 | 112 | 113 | 115 |
| | 7 | 94 | 95 | 96 | 98 | 99 | 100 | 102 | 103 | 104 | 106 | 107 | 108 | 110 | 111 | 112 | 114 |
| | 8 | 93 | 94 | 96 | 97 | 98 | 100 | 101 | 102 | 103 | 104 | 106 | 107 | 108 | 110 | 111 | 113 |
| | 9 | 92 | 94 | 95 | 96 | 98 | 99 | 100 | 101 | 103 | 104 | 105 | 106 | 108 | 109 | 110 | 112 |
| | 10 | 92 | 93 | 94 | 95 | 97 | 98 | 99 | 100 | 102 | 103 | 104 | 106 | 107 | 108 | 109 | 111 |
| | 11 | 91 | 92 | 93 | 95 | 96 | 97 | 98 | 100 | 101 | 102 | 104 | 105 | 106 | 107 | 109 | 110 |
| 10 | 0 | 90 | 91 | 93 | 94 | 95 | 96 | 98 | 99 | 100 | 101 | 103 | 104 | 105 | 106 | 108 | 109 |
| | 1 | 89 | 91 | 92 | 93 | 94 | 96 | 97 | 98 | 99 | 101 | 102 | 103 | 104 | 106 | 107 | 108 |
| | 2 | 89 | 90 | 91 | 92 | 93 | 95 | 96 | 97 | 98 | 100 | 101 | 102 | 103 | 105 | 106 | 107 |
| | 3 | 88 | 89 | 90 | 92 | 93 | 94 | 95 | 96 | 98 | 99 | 100 | 101 | 102 | 104 | 105 | 106 |
| | 4 | 87 | 88 | 90 | 91 | 92 | 93 | 94 | 96 | 97 | 98 | 99 | 101 | 102 | 103 | 104 | 105 |
| | 5 | 86 | 88 | 89 | 90 | 91 | 92 | 94 | 95 | 96 | 97 | 98 | 100 | 101 | 102 | 103 | 104 |
| | 6 | 86 | 87 | 88 | 89 | 91 | 92 | 93 | 94 | 95 | 97 | 98 | 99 | 100 | 101 | 102 | 104 |
| | 7 | 85 | 86 | 87 | 89 | 90 | 91 | 92 | 93 | 95 | 96 | 97 | 98 | 99 | 101 | 102 | 103 |
| | 8 | 84 | 86 | 87 | 88 | 89 | 90 | 92 | 93 | 94 | 95 | 96 | 97 | 99 | 100 | 101 | 102 |
| | 9 | 84 | 85 | 86 | 87 | 88 | 90 | 91 | 92 | 93 | 94 | 95 | 97 | 98 | 99 | 100 | 101 |
| | 10 | 83 | 84 | 85 | 87 | 88 | 89 | 90 | 91 | 92 | 94 | 95 | 96 | 97 | 98 | 99 | 101 |
| | 11 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 99 | 100 |

| | | IX | | | | | | | | X | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 11 | 0 | 82 | 83 | 84 | 85 | 86 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 96 | 97 | 98 | 99 |
| | 1 | 81 | 82 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 93 | 94 | 95 | 96 | 97 | 98 |
| | 2 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 |
| | 3 | 80 | 81 | 82 | 83 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 95 | 96 | 97 |
| | 4 | 79 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 91 | 92 | 93 | 94 | 95 | 96 |
| | 5 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 |
| | 6 | 78 | 79 | 80 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 94 | 95 |
| | 7 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 88 | 89 | 90 | 91 | 92 | 93 | 94 |
| | 8 | 77 | 78 | 79 | 80 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 |
| | 9 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 91 | 92 | 93 |
| | 10 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
| | 11 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 |
| 12 | 0 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 87 | 88 | 89 | 90 | 91 |
| | 1 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
| | 2 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 |
| | 3 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 |
| | 4 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
| | 5 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 |
| | 6 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| | 7 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| | 8 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 |
| | 9 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 |
| | 10 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 |
| | 11 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 79 | 80 | 81 | 82 | 83 | 84 |
| 13 | 0 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 |
| | 1 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 78 | 79 | 80 | 81 | 82 | 83 |
| | 2 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 |
| | 3 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 77 | 78 | 79 | 80 | 81 | 82 |
| | 4 | 68 | 69 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 |
| | 5 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 76 | 77 | 78 | 79 | 80 | 81 |
| | 6 | 67 | 68 | 69 | 70 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 |
| | 7 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 76 | 77 | 78 | 79 | 80 |
| | 8 | 66 | 67 | 68 | 69 | 70 | 71 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| | 9 | 66 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 76 | 77 | 78 | 79 |
| | 10 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
| | 11 | 65 | 66 | 67 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 76 | 77 | 78 |

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|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|--|--|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| 0 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | | | |
| 1 | 64 | 65 | 66 | 67 | 68 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 76 | 77 | | | |
| 2 | 64 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 72 | 73 | 74 | 75 | 76 | 77 | | | |
| 3 | 63 | 64 | 65 | 66 | 67 | 68 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 75 | 76 | | | |
| 4 | 63 | 64 | 65 | 66 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 72 | 73 | 74 | 75 | 76 | | | |
| 5 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | | | |
| 6 | 62 | 63 | 64 | 65 | 66 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 72 | 73 | 74 | 75 | | | |
| 7 | 62 | 63 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 70 | 71 | 72 | 73 | 74 | 75 | | | |
| 8 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 73 | 74 | | | |
| 9 | 61 | 62 | 63 | 64 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 70 | 71 | 72 | 73 | 74 | | | |
| 10 | 61 | 62 | 62 | 63 | 64 | 65 | 66 | 67 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 73 | | | |
| 11 | 60 | 61 | 62 | 63 | 64 | 65 | 65 | 66 | 67 | 68 | 69 | 70 | 70 | 71 | 72 | 73 | | | |
| 15 0 | 60 | 61 | 62 | 63 | 63 | 64 | 65 | 66 | 67 | 68 | 68 | 69 | 70 | 71 | 72 | 73 | | | |

| XI | | | | | | | | | | XII | | | | | | | | | |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| 4 | 150 | | | | | | | | | | | | | | | | | | |
| 5 | 148 | 150 | | | | | | | | | | | | | | | | | |
| 6 | 147 | 148 | 150 | | | | | | | | | | | | | | | | |
| 7 | 145 | 147 | 148 | 150 | | | | | | | | | | | | | | | |
| 8 | 144 | 145 | 147 | 148 | 150 | | | | | | | | | | | | | | |
| 9 | 142 | 144 | 145 | 147 | 148 | 150 | | | | | | | | | | | | | |
| 10 | 141 | 142 | 144 | 145 | 147 | 149 | 150 | | | | | | | | | | | | |
| 11 | 139 | 141 | 142 | 144 | 145 | 147 | 149 | 150 | | | | | | | | | | | |
| 0 | 138 | 139 | 141 | 142 | 144 | 145 | 147 | 149 | 150 | | | | | | | | | | |
| 1 | 136 | 138 | 139 | 141 | 142 | 144 | 145 | 147 | 149 | 150 | | | | | | | | | |
| 2 | 135 | 136 | 138 | 139 | 141 | 142 | 144 | 145 | 147 | 149 | 150 | | | | | | | | |
| 3 | 133 | 135 | 136 | 138 | 139 | 141 | 142 | 144 | 146 | 147 | 149 | 150 | | | | | | | |
| 4 | 132 | 134 | 135 | 137 | 138 | 140 | 141 | 143 | 144 | 146 | 147 | 149 | 150 | | | | | | |
| 5 | 131 | 132 | 134 | 135 | 137 | 138 | 140 | 141 | 143 | 144 | 146 | 147 | 149 | 150 | | | | | |
| 6 | 129 | 131 | 132 | 134 | 135 | 137 | 138 | 140 | 141 | 143 | 144 | 146 | 147 | 149 | 150 | | | | |
| 7 | 128 | 130 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 141 | 143 | 144 | 146 | 147 | 149 | 150 | | | |
| 8 | 127 | 129 | 130 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 142 | 143 | 144 | 146 | 147 | 149 | 150 | | |
| 9 | 126 | 127 | 129 | 130 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 142 | 143 | 144 | 146 | 147 | 149 | 150 | |
| 10 | 125 | 126 | 127 | 129 | 130 | 132 | 133 | 135 | 136 | 137 | 139 | 140 | 142 | 143 | 144 | 146 | 147 | 149 | |
| 11 | 124 | 125 | 127 | 128 | 129 | 131 | 132 | 133 | 135 | 136 | 138 | 139 | 140 | 142 | 143 | 144 | 146 | 147 | |

| | | XI | | | | | | | XII | | | | | | | | |
|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 9 | 0 | 122 | 124 | 125 | 126 | 128 | 129 | 131 | 132 | 133 | 135 | 136 | 138 | 139 | 140 | 142 | 143 |
| | 1 | 121 | 122 | 124 | 125 | 127 | 128 | 129 | 131 | 132 | 134 | 135 | 136 | 138 | 139 | 140 | 142 |
| | 2 | 120 | 121 | 123 | 124 | 126 | 127 | 128 | 130 | 131 | 132 | 134 | 135 | 136 | 138 | 139 | 140 |
| | 3 | 119 | 120 | 122 | 123 | 124 | 126 | 127 | 128 | 130 | 131 | 132 | 134 | 135 | 137 | 138 | 139 |
| | 4 | 118 | 119 | 120 | 122 | 123 | 125 | 126 | 127 | 129 | 130 | 131 | 133 | 134 | 135 | 137 | 138 |
| | 5 | 117 | 118 | 119 | 121 | 122 | 123 | 125 | 126 | 127 | 129 | 130 | 131 | 133 | 134 | 135 | 137 |
| | 6 | 116 | 117 | 118 | 120 | 121 | 122 | 124 | 125 | 126 | 128 | 129 | 130 | 132 | 133 | 134 | 136 |
| | 7 | 115 | 116 | 117 | 119 | 120 | 121 | 123 | 124 | 125 | 126 | 128 | 129 | 130 | 132 | 133 | 134 |
| 10 | 8 | 114 | 115 | 116 | 118 | 119 | 120 | 122 | 123 | 124 | 125 | 127 | 128 | 129 | 131 | 132 | 133 |
| | 9 | 113 | 114 | 115 | 117 | 118 | 119 | 120 | 122 | 123 | 124 | 126 | 127 | 128 | 129 | 131 | 132 |
| | 10 | 112 | 113 | 114 | 116 | 117 | 118 | 119 | 121 | 122 | 123 | 125 | 126 | 127 | 128 | 130 | 131 |
| | 11 | 111 | 112 | 114 | 115 | 116 | 117 | 119 | 120 | 121 | 122 | 124 | 125 | 126 | 127 | 129 | 130 |
| | 0 | 110 | 111 | 113 | 114 | 115 | 116 | 118 | 119 | 120 | 121 | 123 | 124 | 125 | 126 | 128 | 129 |
| | 1 | 109 | 110 | 112 | 113 | 114 | 115 | 117 | 118 | 119 | 120 | 122 | 123 | 124 | 125 | 127 | 128 |
| | 2 | 108 | 109 | 111 | 112 | 113 | 114 | 116 | 117 | 118 | 119 | 120 | 122 | 123 | 124 | 125 | 127 |
| | 3 | 107 | 109 | 110 | 111 | 112 | 113 | 115 | 116 | 117 | 118 | 120 | 121 | 122 | 123 | 124 | 126 |
| 11 | 4 | 107 | 108 | 109 | 110 | 111 | 113 | 114 | 115 | 116 | 117 | 119 | 120 | 121 | 122 | 123 | 125 |
| | 5 | 106 | 107 | 108 | 109 | 110 | 112 | 113 | 114 | 115 | 116 | 118 | 119 | 120 | 121 | 122 | 124 |
| | 6 | 105 | 106 | 107 | 108 | 110 | 111 | 112 | 113 | 114 | 116 | 117 | 118 | 119 | 120 | 121 | 123 |
| | 7 | 104 | 105 | 106 | 108 | 109 | 110 | 111 | 112 | 113 | 115 | 116 | 117 | 118 | 119 | 121 | 122 |
| | 8 | 103 | 104 | 106 | 107 | 108 | 109 | 110 | 111 | 113 | 114 | 115 | 116 | 117 | 119 | 120 | 121 |
| | 9 | 102 | 104 | 105 | 106 | 107 | 108 | 109 | 111 | 112 | 113 | 114 | 115 | 116 | 118 | 119 | 120 |
| | 10 | 102 | 103 | 104 | 105 | 106 | 107 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 117 | 118 | 119 |
| | 11 | 101 | 102 | 103 | 104 | 105 | 107 | 108 | 109 | 110 | 111 | 112 | 114 | 115 | 116 | 117 | 118 |
| 12 | 0 | 100 | 101 | 102 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 113 | 114 | 115 | 116 | 117 |
| | 1 | 99 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 110 | 111 | 112 | 113 | 114 | 115 | 116 |
| | 2 | 98 | 99 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 109 | 110 | 111 | 112 | 113 | 114 | 115 |
| | 3 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 115 |
| | 4 | 97 | 98 | 99 | 100 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 112 | 113 | 114 |
| | 5 | 96 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 110 | 111 | 112 | 113 |
| | 6 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 106 | 107 | 108 | 109 | 110 | 111 | 112 |
| | 7 | 95 | 96 | 97 | 98 | 99 | 100 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 |
| 13 | 8 | 94 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 111 |
| | 9 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 109 | 110 |
| | 10 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 104 | 105 | 106 | 107 | 108 | 109 |
| | 11 | 92 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 |

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| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 12 | 0 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 |
| | 1 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 103 | 104 | 105 | 106 | 107 |
| | 2 | 90 | 91 | 92 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 |
| | 3 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 |
| | 4 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 99 | 100 | 101 | 102 | 103 | 104 | 105 |
| | 5 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 |
| | 6 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 |
| | 7 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 |
| | 8 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 |
| | 9 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 |
| | 10 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 97 | 98 | 99 | 100 |
| | 11 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 13 | 0 | 85 | 86 | 87 | 88 | 89 | 90 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| | 1 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| | 2 | 84 | 85 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 |
| | 3 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 93 | 94 | 95 | 96 | 97 |
| | 4 | 83 | 84 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 |
| | 5 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 |
| | 6 | 82 | 83 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 94 | 95 |
| | 7 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 |
| | 8 | 81 | 82 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 93 | 94 |
| | 9 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 |
| | 10 | 80 | 81 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 90 | 91 | 92 | 93 |
| | 11 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 |
| 14 | 0 | 79 | 80 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 88 | 89 | 90 | 91 | 92 |
| | 1 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
| | 2 | 78 | 79 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 87 | 88 | 89 | 90 | 91 |
| | 3 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 90 |
| | 4 | 77 | 78 | 79 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 86 | 87 | 88 | 89 | 90 |
| | 5 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 88 | 89 |
| | 6 | 76 | 77 | 78 | 79 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 85 | 86 | 87 | 88 | 89 |
| | 7 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 88 |
| | 8 | 75 | 76 | 77 | 78 | 79 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 85 | 86 | 87 | 88 |
| | 9 | 75 | 76 | 76 | 77 | 78 | 79 | 80 | 81 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 87 |
| | 10 | 74 | 75 | 76 | 77 | 78 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 84 | 85 | 86 | 87 |
| | 11 | 74 | 75 | 76 | 76 | 77 | 78 | 79 | 80 | 81 | 81 | 82 | 83 | 84 | 85 | 86 | 86 |
| 15 | 0 | 73 | 74 | 75 | 76 | 77 | 78 | 78 | 79 | 80 | 81 | 82 | 83 | 83 | 84 | 85 | 86 |

| XIII | | | | | | | | | | XIV | | | | | | | | | |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|--|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | | |
| 8 | 150 | | | | | | | | | | | | | | | | | | |
| 8 9 | 149 | 150 | | | | | | | | | | | | | | | | | |
| 10 | 147 | 149 | 150 | | | | | | | | | | | | | | | | |
| 11 | 146 | 147 | 149 | 150 | | | | | | | | | | | | | | | |
| 0 | 144 | 146 | 147 | 149 | 150 | | | | | | | | | | | | | | |
| 1 | 143 | 144 | 146 | 147 | 149 | 150 | | | | | | | | | | | | | |
| 2 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | | | | | | | |
| 3 | 140 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | | | | | | |
| 4 | 139 | 140 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | | | | | |
| 5 | 138 | 139 | 141 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | | | | |
| 9 | 6 | 137 | 138 | 139 | 141 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | | |
| 7 | 136 | 137 | 138 | 140 | 141 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | | |
| 8 | 154 | 136 | 137 | 138 | 140 | 141 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | | | | | | |
| 9 | 133 | 135 | 136 | 137 | 138 | 140 | 141 | 142 | 144 | 145 | 146 | 148 | 149 | 150 | | | | | |
| 10 | 132 | 133 | 135 | 136 | 137 | 139 | 140 | 141 | 142 | 144 | 145 | 146 | 148 | 149 | 150 | | | | |
| 11 | 131 | 132 | 134 | 135 | 136 | 137 | 139 | 140 | 141 | 142 | 144 | 145 | 146 | 147 | 149 | 150 | | | |
| 0 | 130 | 131 | 133 | 134 | 135 | 136 | 138 | 139 | 140 | 141 | 143 | 144 | 145 | 146 | 148 | 149 | | | |
| 1 | 129 | 130 | 132 | 133 | 134 | 135 | 136 | 138 | 139 | 140 | 141 | 143 | 144 | 145 | 146 | 148 | | | |
| 2 | 128 | 129 | 130 | 132 | 133 | 134 | 135 | 137 | 138 | 139 | 140 | 141 | 143 | 144 | 145 | 146 | | | |
| 3 | 127 | 128 | 129 | 131 | 132 | 133 | 134 | 135 | 137 | 138 | 139 | 140 | 142 | 143 | 144 | 145 | | | |
| 4 | 126 | 127 | 128 | 130 | 131 | 132 | 133 | 134 | 136 | 137 | 138 | 139 | 140 | 142 | 143 | 144 | | | |
| 5 | 125 | 126 | 127 | 128 | 130 | 131 | 132 | 133 | 134 | 136 | 137 | 138 | 139 | 140 | 142 | 143 | | | |
| 10 | 6 | 124 | 125 | 126 | 127 | 129 | 130 | 131 | 132 | 133 | 135 | 136 | 137 | 138 | 139 | 141 | 142 | | |
| 7 | 123 | 124 | 125 | 127 | 128 | 129 | 130 | 131 | 132 | 134 | 135 | 136 | 137 | 138 | 139 | 141 | | | |
| 8 | 122 | 123 | 124 | 126 | 127 | 128 | 129 | 130 | 131 | 133 | 134 | 135 | 136 | 137 | 138 | 140 | | | |
| 9 | 121 | 122 | 123 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 133 | 134 | 135 | 136 | 137 | 138 | | | |
| 10 | 120 | 121 | 122 | 124 | 125 | 126 | 127 | 128 | 129 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | | | |
| 11 | 119 | 120 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | | | |
| 0 | 118 | 119 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | | | |
| 1 | 117 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | | | |
| 2 | 116 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | | | |
| 3 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | | | |
| 4 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | | | |
| 5 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | | | |
| 11 | 6 | 113 | 114 | 115 | 116 | 117 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | | | |
| 7 | 112 | 113 | 114 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | | | |
| 8 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 126 | 127 | 128 | | | |
| 9 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 125 | 126 | 127 | | | |
| 10 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | | |
| 11 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | | |

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XIII

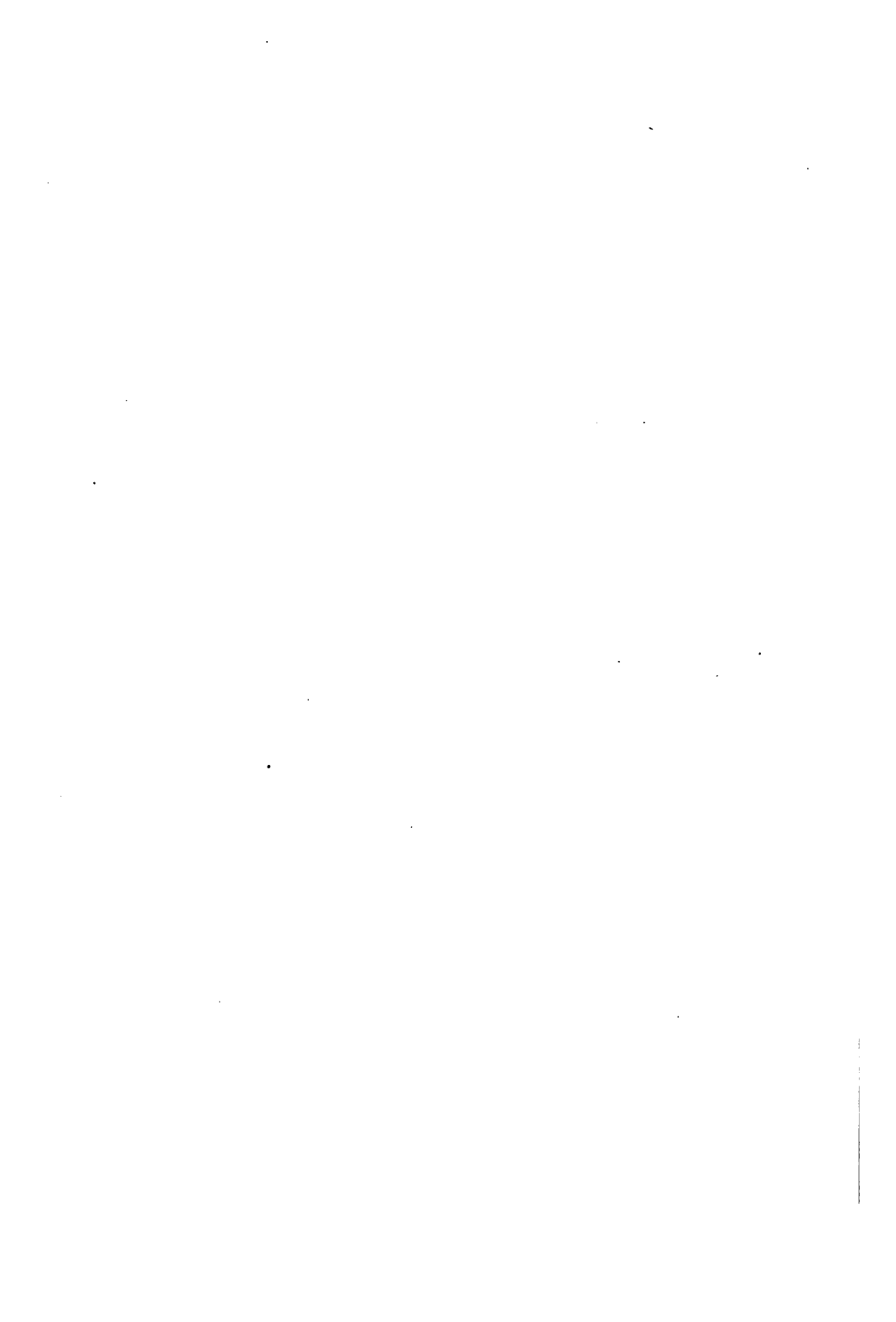
XIV

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0 | 108 | 109 | 110 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 |
| 1 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 |
| 2 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 |
| 3 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 |
| 4 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 |
| 5 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| 6 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 |
| 7 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 |
| 8 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 |
| 9 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 |
| 10 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 |
| 11 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 |
| 0 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 |
| 1 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 |
| 2 | 99 | 100 | 101 | 102 | 103 | 104 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 |
| 3 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 109 | 110 | 111 | 112 |
| 4 | 98 | 99 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 |
| 5 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 |
| 6 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 107 | 108 | 109 | 110 |
| 7 | 96 | 97 | 98 | 99 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 |
| 8 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 103 | 104 | 105 | 106 | 107 | 108 | 109 |
| 9 | 95 | 96 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 105 | 106 | 107 | 108 |
| 10 | 94 | 95 | 96 | 97 | 98 | 99 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 |
| 11 | 94 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 102 | 103 | 104 | 105 | 106 | 107 |
| 0 | 93 | 94 | 95 | 96 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 105 | 106 |
| 1 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 |
| 2 | 92 | 93 | 94 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 102 | 103 | 104 | 105 |
| 3 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 104 |
| 4 | 91 | 92 | 93 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 99 | 100 | 101 | 102 | 103 | 104 |
| 5 | 90 | 91 | 92 | 93 | 94 | 95 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 102 | 103 |
| 6 | 90 | 91 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 99 | 100 | 101 | 102 | 103 |
| 7 | 89 | 90 | 91 | 92 | 93 | 94 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 100 | 101 | 102 |
| 8 | 89 | 90 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 96 | 97 | 98 | 99 | 100 | 101 | 102 |
| 9 | 88 | 89 | 90 | 91 | 92 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 98 | 99 | 100 | 101 |
| 10 | 88 | 89 | 89 | 90 | 91 | 92 | 93 | 94 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 100 |
| 11 | 87 | 88 | 89 | 90 | 91 | 91 | 92 | 93 | 94 | 95 | 96 | 96 | 97 | 98 | 99 | 100 |
| 15 0 | 87 | 88 | 88 | 89 | 90 | 91 | 92 | 93 | 93 | 94 | 95 | 96 | 97 | 98 | 98 | 99 |

| XV | | XV | | XV | | XV | | XV | |
|----|--------|----|--------|----|--------|----|--------|----|--------|
| | 0 | | 0 | | 0 | | 0 | | 0 |
| | 0 150 | | 0 137 | | 0 125 | | 0 115 | | 0 107 |
| | 1 149 | | 1 135 | | 1 124 | | 1 115 | | 1 107 |
| | 2 148 | | 2 134 | | 2 123 | | 2 114 | | 2 106 |
| | 3 146 | | 3 133 | | 3 122 | | 3 113 | | 3 105 |
| | 4 145 | | 4 132 | | 4 122 | | 4 113 | | 4 105 |
| | 5 144 | | 5 131 | | 5 121 | | 5 112 | | 5 104 |
| 10 | 6 143 | 11 | 6 130 | 12 | 6 120 | 13 | 6 111 | 14 | 6 104 |
| | 7 142 | | 7 130 | | 7 119 | | 7 111 | | 7 103 |
| | 8 141 | | 8 129 | | 8 119 | | 8 110 | | 8 102 |
| | 9 140 | | 9 128 | | 9 118 | | 9 109 | | 9 102 |
| | 10 139 | | 10 127 | | 10 117 | | 10 109 | | 10 101 |
| | 11 138 | | 11 126 | | 11 116 | | 11 108 | | 11 101 |







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